HEALTH LECTURES

BY

WILLIAM WHITELAW, M.D.

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FIVE

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PREFACE.

These Five Health Lectures are now published, in deference to the expressed desire of many friends. The close attention paid to them when delivered in Cupar, and the favourable reception accorded to them as they appeared in the columns of the *Fife Herald*, lead to the hope that they may be welcomed in a collected form. I shall be indeed pleased if they are the means of drawing greater attention to the care of the body, and of inspiring a desire on the part of my fellow-townsmen to enquire further into the laws of Health.

WM. WHITELAW.

November 1882.

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HEALTH LECTURES.

No. I.

FOOD AND DRINK.

It has been said that a little knowledge is a dangerous thing, and that the man who is his own physician has a fool for his patient; but, on the other hand, it is surely true that a little knowledge is better than none, and it may be safely asserted that many forms of disease now prevalent amongst us might be altogether averted, or, at least, mitigated, by more extensive information on the laws of Health. The numerous courses of lectures on Sanitary matters which have this winter been delivered in various parts of the country are a sufficient proof of the interest taken by the public in a subject of such vast importance to the well-being of the human race;

and the large audience I see before me to-night assures me that Cupar does not resent my humble attempt to throw a little light on some of the commoner, but most essential, requirements of a healthy life. We begin the course to-night with "Food and Drink." Before going on to discuss in detail the various articles of diet in common use, I must touch on the preliminary question—Why should we require to eat at all?

The human body has been likened to a steam-engine, and the illustration, though only an illustration, and by no means a perfect one, will serve for our purpose to-night. A steam-engine, when once set going, will keep working so long as you supply water to the boiler and fuel to the fire, but only so long. Cease the supply of water, let out your fire, and the mechanism comes to a stand. But further than this, keep the engine working for a sufficient length of time, and by-and-bye wear and tear will tell on its substance. The boiler gets thin, pins get slackened, and repairs are from time to time required, till a time comes when it can be no longer patched up, and its career of usefulness is over. So far the analogy holds good with our bodies. We do our work in the world as long as we have sufficient fuel sup-

plied to us in the shape of food and drink. Occasionally our mechanism goes wrong from accident or disease, till at length it gets worn out past all possibility of repair, and our little day is done.

The body is composed of various tissues, muscular, fatty, nervous, and so on, which are being continually used up. Every time we lift a finger we use up muscle; every time we speak, move, wink our eyes, aye, and even think to ourselves, we are consuming tissue of some sort. The labouring man doing his day's work with his hands, the professional classes with their brains, and the man of leisure whiling away the tedious hours, are all destroying their tissues, as the fire consumes coal. But besides these sources of waste which are continually evident and patent, there are processes going on perpetually during life, which involve an immense amount of consumption of our substance. We do not often think of the amount of work done by the heart. This organ, in propelling the blood to all parts of the body, is estimated to exert an amount of force during a week sufficient to lift a man weighing 11 stones $2\frac{1}{2}$ miles high. Then we have respiration occurring 14 or 15 times every minute, and further we have

the waste of material involved in the production of heat, which warms the blood, and is distributed throughout the body by it, as by a system of hot water pipes. Without going into detail I may say that a man to do his day's work will lose about 10 lbs. of matter; 7 lbs. of this being water thrown off by the lungs, skin, and kidneys; and one way and another he expends enough energy during a week to raise his body 56 miles high. A notable proof that we are skilfully as well as fearfully and wonderfully made, lies in the fact that the body works more *economically* than any machine hitherto invented by man. The best constructed steam engine will yield only 1-8th, in effective mechanical work, of the energy supplied to it; whereas the living body will give back between 1-4th and 1-5th of the total energy conveyed to it by the food and air. Again, in the engine, the remaining 7-8ths are expended in heat, which is lost; but in the body the heat is of the utmost importance, and could not be dispensed with. So great, then, being the daily loss of substance, it is absolutely necessary that an equivalent amount of fuel should be daily supplied, and we further see this necessity in the fearful effects of a total deprivation of food,

or starvation; and here we find our illustration of the steam engine failing us. When the fuel is no longer added to the fire, the steam engine stops. It has no inherent power of repairing waste or of developing energy from within as we have. Our bodies have the power of feeding on their own substance for a time, but only for a time; although it is surprising how long life can be sustained without food, especially if water be supplied. About a *week* may be taken as the usual period. Whenever the original weight of the body is reduced to 6-10ths death takes place, so that *insufficient* supply of food is as fatal, but not so rapidly so, as total deprivation. The famous case of Dr Tanner was an example of the circumstance that water prolongs life; although considering that he was allowed whisky and beef-tea, and was not thoroughly watched by reliable independent persons, his ridiculous experiment was of no use to science. A fearful thing is starvation. We all know what it is to feel hunger, that sign that our body is needing food; but, between the gentle stimulus of appetite and the agony of starvation there are infinite gradations. Hunger has its good side and its bad. Under its influence we are impelled

to work, and by its imperious demands are forced to labour, but when unsatisfied it becomes a devouring flame, destroys all that is most noble in man—it subjugates his humanity and makes the brute predominate. Impelled by this ferocious instinct, shipwrecked and starving seamen have even eaten their companions, and savage races have devoured unhappy mariners cast on their inhospitable shores.

It is perhaps not for us, however, to cast a stone at these cannibals, for St Jerome gives his personal testimony that, when he was a little boy, he beheld the Scots, a people of Britain, eating human flesh, and though there were plenty of cattle and sheep at their disposal, yet they preferred a ham of the herdsman or a slice of the breast as a luxury.

A somewhat ambiguous tribute to the supposed advantages of smoking and chewing tobacco is given in the story of a crew wrecked on the coast of New Zealand. The cannibals had eaten all the men except the captain and the mate who were constant smokers and chewers. That fortunate pair were spared, and the explanation offered by the chief was that they would not make pleasant eating as they would taste quite too, too utterly horribly of tobacco !

Akin to Hunger is Thirst—the sign that there is a deficiency of liquid in the body, although it may be, and often is, produced, when there is no such deficiency, nothing but a local disturbance in the throat. We require to consume an immense amount of liquid, but we shall have more to say about this presently. Food, then, is a necessity. Waste is continually going on, repairs are as constantly being made from the blood ; and food, when properly digested, supplies the loss the blood has sustained. In short, we must take in material for building up the body during youth, in maturity to repair waste, and throughout life from birth to death to develop energy and to maintain heat.

The various tissues of the human body are all composed of these elements :—

Carbon.	Sodium.
Hydrogen.	Potassium.
Oxygen.	Calcium.
Nitrogen.	Magnesium.
Phosphorus.	Iron.
Sulphur.	Fluorine.
Chlorine.	

For the most part these are each in combination with one or more ; as for example—Hydrogen and Oxygen form Water ; Phos-

phorus and Calcium form Phosphate of Lime; Chlorine and Sodium, Chloride of Sodium, or common Salt, and so on. These are the elements which are being constantly wasted or used up, and which must be as constantly replaced; hence our food must contain these, or be of such a composition as to be resolved into these in the system.

Food is classified by chemists into Organic and Inorganic, and we shall find it convenient to examine these two classes first, and then to discuss individual articles of diet under the simpler and more popular classification of Liquids and Solids.

We shall first take the Inorganic articles of diet. Strange to say, these are the more important of the two, and consist of water and various minerals. It may seem odd to refer to minerals as food, or to call water highly nutritious; and it is exceedingly likely that the casual acquaintance to whom you might mention your opinion that water was more valuable as an article of diet than roast beef, and that common salt was more absolutely required for nutrition than white of egg, would feel somewhat nervous, and look anxiously round to make sure your keeper was at hand. And yet you would be strictly accurate in your statement, and

your astonished friend would readily acquiesce in your opinion when informed that two-thirds of the living body consist of water; while as regards minerals we have iron in the blood, phosphate of lime in the bones, and common salt forms an essential part of almost all organic fluids and solids. "If we do not exactly dine off minerals," says Lewes, "nor find ourselves pleasantly munching a lump of chalk, we nevertheless swallow these as constituents of other substances used in our ordinary diet." Every time we breathe we throw out water, as we may see when our breath condenses on the cold surface of glass or steel, and when in frosty weather the atmosphere is sufficiently cold to condense our breath as it issues from our mouths. We also lose a great deal of water by perspiration, which in hot weather or during violent exercise causes streamlets of water to flow over our skins. It is calculated that there are no less than 28 miles of tubing in the skin of each person from which water is always escaping sensibly or insensibly. Many people say they never sweat, but they do so without knowing it. Under ordinary circumstances, we lose from two to three lbs. daily, but during hard work or violent exertion of any kind, we lose a very great deal more.

If these little ducts get closed up with dirt the sweat is kept in, and very serious results are apt to ensue. We therefore see the importance of keeping the skin clean. It is wonderful the amount of uncleanness some people manage to accumulate. Some of you may have heard the story of the Irishman who was induced to have a Turkish bath. After the bath-man had rubbed off layer after layer of dirt, he came upon, what Pat had forgotten all about, an old flannel waistcoat! We have no excuse for dirt in Cupar. We have an abundant supply of good water, and although we pay dearly for it, we may get good value by using it freely, both internally and externally.

Besides the water we drink as such, and some people scarcely ever taste it unmixed, we take in much liquid with our food. Beef and other articles of diet, more particularly vegetables, are largely composed of water. [Experiment—Distilled turnip.] Here we have a turnip which was distilled this afternoon. See the large quantity of water—nearly 90 per cent.—and the small amount of solid residue.

Of minerals, common salt is abundant in all varieties of animal food. Phosphorus we get in flesh, and especially in the flesh of

fishes. Sulphur is contained in eggs, turnips, cauliflowers, peas, and beans. Potassium abounds in milk and in most inland plants. Lime we have in eggs, milk, flesh and bones. Iron we consume in the yolk of the egg, in milk, and to some extent in most vegetables.

The Organic compounds used as food are derived partly from the animal and partly from the vegetable kingdoms, and may be conveniently divided into the following classes :—

1. Albumen.
2. Starches and Sugars.
3. Oils and Fats.
4. Gelatine.
5. Acids.

1. The albuminous substances include meats, milk, eggs, bread, &c., &c. They are composed of carbon, hydrogen, nitrogen, and oxygen, the first four elements, and are all capable of supplying material both for the nutrition and repair of the tissues, and also for maintaining heat. You will notice that they alone contain nitrogen, and are therefore frequently spoken of as the nitrogenous foods. Whether derived from the vegetable or animal kingdom they are all reduced to the same material in digestion, and are called *peptones;* so that it is a

matter of little consequence whether we draw our supplies from the flesh of animals, white of egg, curd of milk, grain of wheat, or the seed of the pea. No matter what they are when we put them in our mouth, they leave the stomach exactly alike. Here I have specimens which have been digested with gastric juice at the temperature of the stomach. You will observe they are quite the same.

2. The starches and sugars include all those substances derived from the vegetable world, which are analogous to sugar, such as arrowroot, sago, potatoes, &c. These are all largely composed of water and carbon. [Here sulphuric acid was poured on sugar, and a mass of black carbon resulted.]

3. Oils and fats are obtained both from vegetables and animals. Like the starches and sugars they cannot alone support life, but are of great use in maintaining the heat of the body. They contain a great preponderance of carbon and hydrogen, very little oxygen, and no nitrogen.

4. Gelatine is obtained from animals only —chiefly from bone—and though not destitute of nutritive value, cannot take the place of albumen. Calf's foot and other jellies, often given to invalids, are pleasant to

swallow, but are of little use as nourishment and should not be relied on for that purpose. Beef or mutton, and chicken boiled down to a jelly are of far more value, because they are albuminous.

5. Acids are received in vegetables, and have their use in the process of digestion.

These are the chemical divisions of food; but no individual food we eat consists of any one of these alone. For instance, oatmeal contains both starch and albumen, besides water and salts. Beef contains albumen, water, minerals, and so on, and we thus see how it is that we get all the necessary elements into our system. Plants absorb minerals from the soil, animals eat the plants, and we eat the animals and vegetables both, and so get the benefit of the manufactured article. Take this pudding for example, made of *flour*, which contains starch and albumen; *suet*, containing oil; *milk*, which contains all the elements; *jam*, containing acid and sugar, and water in all these. [The pudding was handed down to the audience to be eaten.]

As all these elements must be got into the system somehow, it is evident that the most *economical* diet is that in which there is the most perfect apportionment of the several classes of

constituents to the wants of the system, and these wants will vary according to the amount of muscular exertion put forth, and to the elevation or depression of the external temperature. Thus, the South American hunter, who spends the whole day in the saddle and in a constant state of activity, scarcely ever tastes anything but beef—the temperature of the surrounding atmosphere being so high that the body has no occasion to generate more heat than is supplied by the combustion of the albumen of the food. Again, the Esquimaux and other dwellers upon the Arctic seas, find in the bodies of the whales and seals that special supply of the very best combustive material, which alone can enable them to maintain their existence in a climate where the thermometer is for many months at 40°, and where the amount of heat which must be generated within the body is 4 or 5 times that for which a bread diet will suffice. In our own climate, the variations of the seasons demand a corresponding change of diet—meat and oils in the winter, vegetables and little fat in the summer. (Carpenter.)

We shall now endeavour to apply all these theoretical and chemical considerations to the principal articles of our diet, and for

this purpose we shall divide all food into two classes, the LIQUIDS and SOLIDS.

I. The LIQUIDS, which are of various kinds.

We have (1) *The Mucilaginous, Farinaceous or Saccharine drinks*, which are toast water, barley water, gruel, and such like. These are slightly nutritive, and differ but little from common water. They are chiefly used in the sick room.

(2) *Aromatic, or Astringent drinks*, which are tea, coffee, chocolate, and cocoa. There are few facts better established than that tea and coffee, no less than wine and beer and narcotics, increase the activity and power of the body, while they diminish its waste. No one will deny the refreshing effect of the "cup that cheers and not inebriates," after a fatiguing day's work ; and every one who has had occasion to sit up at night (it may be at the sick-bed of one near and dear) knows the stimulating effect of a cup of coffee. More work can be done with a given amount of food by the tea or coffee drinker than by the water drinker with the same amount of food. But do not misunderstand me. These good effects are only obtained when tea and coffee are used in moderation. Used in excess they lead to complete disorganization of the nervous

system, and are not an uncommon cause of paralysis. How frequently do we see the teapot in a chronic condition of infusion on the hob, and how constantly do we find in the same houses indigestion, nervousness, palpitation of the heart, and irritable tempers! It is very usual for millworkers, masons, and other work people to carry cold tea with them for their dinner. I do not think this is wise. Milk would be cheaper in the long run, and far more nutritious. The fashionable afternoon tea has also a great deal to answer for. Tea should *never* be given to infants, and, as a rule, it is not suitable for young children; but it supplies a most excellent stimulating drink for the aged of both sexes. Tea and coffee are nearly identical in their composition—water, theine, caseine, gum, sugar, tannic acid, aromatic oil, &c. The caseine is nutritious, and resembles that part of milk from which cheese is made; but unless we add a little soda to the water in which we make tea or coffee it is not extracted. There is 26 per cent. of tannic acid in tea, and this is why cold tea makes such a good astringent lotion for inflamed eyes. For those who find tea in moderation hurtful, cocoa or chocolate are useful substitutes. They contain oils

and starch, and often agree well with the dyspeptic.

(3) *Acidulous drinks* are lemonade, ginger beer, soda water, raspberry vinegar, and such like. They contain carbonic acid gas, and are on that account highly refreshing and excellent for allaying thirst.

(4) *Drinks containing Gelatine.*—These are broths and soups, and if properly prepared contain all the soluble constituents of the articles out of which they are made. To get all the good out of meat into soup, it should be placed in cold water, and very gradually heated, kept boiling for a few minutes, and then strained and pressed. The thinner the piece of meat and the smaller it is chopped down, the more easily do we extract its juices. Soups are exceedingly nutritious, and mostly contain an admixture of meat and vegetables—such as peasoup, potato soup, rice soup, and so on. Amongst soups we must give a foremost place to our own Scotch broth and hotch potch, to which, along with porridge and milk, much of our superior attainments and success in life is mainly due.

(5) *Emulsive or milky drinks*—the chief of which is the milk of the cow. Milk is the model food, containing as it does all the

chemical elements—albumen, starch, sugar, oil, and acid. It contains caseine from which cheese is made, phosphate of lime and other salts, and more or less water according to the kind of animal from which it is derived, and according to the kind of tail that animal possess. (Here the lecturer pumped vigorously.) Milk is the natural food of the young, and nothing can take its place. In bringing up a baby on the bottle, the milk should be obtained from *one* cow only, and a fresh supply got in at least twice a-day. At first half milk and half water may be used, gradually diminishing the quantity of water as the child grows older. A little sugar and the least little pinch of salt should also be added. Regularity of feeding should be followed from the first. Nothing is more absurd than to give a child its bottle every time it cries. In the sick-room milk is invaluable, and it is perhaps worth remembering, that in cases of diarrhœa or dysentery, boiling it renders it a very good remedy by itself. Although milk alone is all that is necessary, and indeed is all that should be given for the first 4 or 5 months of infantile life, we do not find that adults thrive on an exclusively milk diet. They require something more than that. A

man will keep in health on bread and water, but not on milk alone.

It may be metioned that asses' milk most closely resembles human milk of all others; goats' milk is very rich; and besides these we have the proverbial milk in the cocoa nut.

(6) The last division of drinks I approach with reluctance; so much controversy exists and such great diversity of opinion is held regarding their use and abuse. I refer, of course, to the alcoholic drinks, which include wines, beer, porter, and spirits. The use and abuse of these articles have their moral and social as well as their physiological aspect. It is almost superfluous to dwell on the dangers which surround the use of alcohol. Drunkenness is a hideous vice, destroying both body and mind, costly alike to the pocket and to the health. No one can deny the serious influence it exerts on human welfare. So glaring are the evils of intemperance, that we must always respect the motives of temperance societies, and may willingly excuse the too frequent exaggerations of those zealous men who advocate total abstinence for all. But between use and abuse there is surely a wide gulf. In small doses alcohol is no more a poison,

and will no more produce insanity, pauperism, and crime, than tea taken in moderation will cause nervous disease or paralysis. In excess *all* things are bad—too much tea ; too much drink ; and, for that matter, too many mutton-chops ; and without wishing for a moment to retort on teetotallers the insinuations they are continually making against the moderate drinker, I must observe that the remarkable appetite of the total abstainer is notorious. Liebig, of beef tea fame, reports the experience of a landlord of a Hotel at Frankfort during the Peace Congress. The members were mostly teetotallers, and a regular deficiency was observed every day in certain dishes, especially farinaceous dishes, such as puddings. So unheard-of a deficiency, in an establishment where for years the amount of dishes for a given number of persons had so well been known, excited the landlord's astonishment, and he found that they made up in pudding what they neglected in wine. (Lewes.) From this we may conclude that alcohol is really a food, although candour compels me to say that physiologists are much divided in opinion on this subject. As for the argument that, allowing the moderate use of alcohol to be harmless,

there is constant and great danger of the moderate drinker becoming a drunkard, I think our experience and common sense are opposed to the view that this takes place to any great extent. Still, if you wish to be safe, absolutely free from temptation, be a teetotaller, for perfect health is quite compatible with total abstinence, only you must make up your mind to eat more food.

Examining alcoholic drinks in detail, we find beer to be an extract from malt and hops, containing alcohol, sugar, acid and salts, and water. The water of Burton is generally credited with the excellence of the beer sent out by Bass and Alsopp. As an article of diet, beer and also porter, which is simply coloured beer, are very fattening, sustain the animal heat, and act as a bitter tonic. When taken in daily excess, beer causes gradually a state of fulness of the system, appetite lessens, and the formative power of the body is impaired, and we have some of those affections classed as gouty and bilious disorders. The question, What is excess? is not easy to answer. That will depend on the kind and quality of the beer, and on the habits and life of those who use it. One important consideration is always to take it along with food.

Wines are a large and extensive class of alcoholic drinks. Ranging from the cheap and unwholesome gooseberry of our own country to the high-priced and delicate vintages of the Rhine, we have from Spain and Portugal port and sherry, which are largely used in this country, and play an important part in the production of gout; from France, Germany, and Italy numerous cheap wines, Bordeaux and Burgundies, which are getting into common use here, and are excellent accompaniments to diet. Moselle sends us champagne, which is a valuable remedy in cases of sickness, obstinate vomiting, and unsteadiness of the stomach. Besides containing a small proportion of alcohol, wines possess the carbohydrates and salts, and some albuminous substances, and are therefore of considerable value as dietetics. To define what is moderation in the use of wine is as impossible as in the case of beer; and that most persons, even in these days of comparative temperance, take too much is highly probable. A point of this kind must be settled by individual experience. The weak wines, claret, and such like, which contain 6 to 10 per cent. alcohol, should be used in preference to the strong wines, port and sherry, which contain

15 to 23 per cent. of alcohol; but there is no doubt that wine is unnecessary as an article of diet, and that many persons are much better without it.

Spirits, comprising brandy, gin, whisky, and rum, are in too common use, and are much more hurtful than wine or beer. It has been truly said, that if spirits were unknown, half the sin and much of the poverty and unhappiness in the world would disappear. "It is a cold day," says some one, "I must have a glass of whisky." Does the whisky warm him? It most certainly does not. On the other hand, it actually lowers his temperature, although, by dulling the nervous system, he may not for a very short time feel the cold so keenly as he did. "The experiences of Arctic explorers, and of our countrymen in the cold whaling grounds, prove this; and the Alpine guides at Chamounie and the Bernese Oberland, when out in winter, have invariably found spirits hurtful." (Parkes.)

Against great heat, spirits are equally futile, and the diseased livers, which are brought back from tropical climes, are too often due to a want of care on this point. It lessens perspiration, and so diminishes the protection against heat that that affords.

If you must take spirits, that is, if you will

persist in taking what you know does you no good, and *may* do you harm, I advise you to take it in plenty of cold water, not hot, and never to take it except along with food. I cannot *too strongly* protest against the constant nipping which goes on in our midst.

We now come to SOLIDS: and foremost amongst these we must place the articles of food which we obtain from the *butcher and poulterer*. The flesh of most herb-eating animals both wild and domestic is both agreeable and nutritious, and contains some of the chief alimentary principles—albumen, fibrine, fat, gelatine, water, and salts, besides a peculiar substance called osmazone, which gives the characteristic flavour to beef and mutton.

The flesh of young animals is more tender than that of adults, although not always more digestible. For instance, veal is less so than beef; and chicken texture, being so much closer than the fibre of beef, is less readily acted on by the gastric juice; still chicken often suits a delicate stomach, and will be digested when we shouldn't expect it. The difference between lamb and mutton is very marked, especially in their fat—that of mutton containing more fatty acid, and being to many stomachs quite intolerable.

All the savoury constituents of flesh are contained in the juice, and the residue is merely fibre of little nutritive value. After removing all the juice, the residue is of the same quality in different animals, so that it is impossible to tell beef from poultry, or venison from pork, and by adding the juice of beef or poultry to the exhausted flesh of a deer, the meat thus prepared cannot be distinguished by the flavour from roast beef or fowl. (A specimen was handed down and consumed by the audience.) The comparative merits of different kinds of butcher meat are not easily determined, such variations occur in different individuals, and in the same individuals at different times. Tripe is the most easily digested of them all, requring about an hour only; lamb, $2\frac{1}{2}$ hours; roast beef, 3 hours; boiled mutton and stewed pork, each 3 hours; while roasted pork requires $5\frac{1}{4}$ hours.

As may be expected, the flesh of different parts has different qualities—the breast of birds is more tender than the legs, and the legs than the wings. In the woodcock the legs are always preferred, while in the partridge the wings are mostly affected by epicures.

The flesh of all water fowl, especially

the goose, is penetrated with fat. Turkey and goose, when roasted, require about 2½ hours to digest, roasted fowls require 4 hours, and ducks much about the same.

Besides the meat, the brains, livers, kidneys, and sweetbread of various animals are eaten. On account of the fat and oil contained in the brain and liver they are apt to disagree. Kidneys are very tough and difficult to digest. Sweetbread forms a favourite food for invalids.

Tripe, which is the stomach of ruminant animals, contains a large proportion of albumen and fibrine, and as it only requires one hour for its digestion is a very suitable dish for supper. "There is no nightmare in it." (Lewes.)

We don't, to our knowledge, eat horses in Cupar, but there is no reason beyond prejudice why we should not. During the Siege of Paris the inhabitants were very glad to eat both them and rats, and reported them to be very good.

Salted meat is not very nutritious, the brine taking away much of the nourishing material.

The preserved meat, known in our midst as Chicago, is as good as our own beef, but it must be thoroughly masticated before

being swallowed, so that the gastric juice may get at it. The preserved tongues, beef, and mutton can be bought so cheaply and so well cooked that they are well worth the attention of the working-classes.

Similar to beef in many ways is *fish*, which corresponds to that of meat, with the advantage of containing a considerable quantity of phosphorus, which is good for the brain and nervous system. This is what Mark Twain refers to when asked by a contributor how much fish he ought to take to make his brain work well; he replies that his young friend would require to swallow a whale; not a big whale, says Mark, but just an ordinary middle-sized kind of a whale. Our humorist forgot that a whale is *not* a fish; but that is a detail.

Many kinds of fish have large quantities of oil, and on this account eel, salmon, herring, and sprat are not very digestible. Oil is most abundant in the thin part of salmon, which is on that account preferred by epicures. Cod, whiting, flounder, and turbot have no oil except in the liver, and so are easily digested. The facility with which Cod Liver Oil can be consumed, valuable as it is for those of weak chests, is quite an acquired taste. Frying renders

fish less digestible than boiling, and people with delicate digestions should avoid the skin of fried fish, as also dried, smoked, salted, and pickled fish. Fish is an agreeable change in our diet.

Next in importance comes the *baker*. From him we get our rolls in the morning, our pastry for dinner, and our cookies and shortbread for tea. Bread is made by fermenting and baking the ground grain of wheat. Good bread ought to be a spongy-looking mass from which layers can be readily detached, and the loaf crumbled down by the fingers into a coarse powder. It owes its great nutritive power to the presence of gluten. Stale bread is better than quite new bread. Rolls to breakfast and cookies for tea are not suitable for those who are not allowed to forget they have stomachs. All bread should be well masticated before being swallowed. Pastry is of two kinds, puff and short—the latter is the more digestible because the butter is thoroughly mixed with the dough, and so is in more minute division. Shortbread and fancy bread generally should be sparingly used.

The *greengrocer* next. Vegetables are mainly nutritious on account of the starch

and sugar, salts, and large quantity of water (nearly 80 per cent.), which they contain. The bread—the staff of life—is, of course, of vegetable origin; but besides it we have oats, potato, rice, sago, arrowroot, tapioca, turnips, peas, beans, &c., &c. These ought all to be well-cooked, or, if eaten raw as salads, should be carefully washed, otherwise we are very apt to swallow what may cause intestinal worms.

We have not time to go into the question of vegetarianism further than to state that man seems to thrive best, and to be able to do most work, on a mixed diet. His organs, too, are formed for the digestion of all kinds of food, and it is no more cruelty to wring the neck of a hen, than it is to kill the myriads of animal organisms which we destroy in every glass of water we drink.

Potatoes ought to be eaten along with some albuminous compound—beef or mutton. The cooking is a very important item, boiling being the best mode. The water in which they are boiled is not wholesome, and should never be used for diet.

Turnips contain 90 to 96 per cent. of water, and are best when cooked, but the young stomach can eat them raw, and many

of you, I daresay, can recall the rapture with which you ate your stolen swedes.

Of the other vegetables in our gardens, cabbages, cauliflowers, lettuce, and all these, the same remarks may be made. The gentle housewife, familiar with starch only in its relation to the wash-tub, will be surprised to learn that we are eating it when we have sago, tapioca, rice, &c. These are all good, but require to be boiled in order to burst the starch cells. Young infants should never get starch foods before six months, as their salivary glands are not formed. You all know the value of oatmeal porridge too well to require any recommondation of it from me. Boil as long as you like, and stir well. Besides starch, oatmeal is rich in albumen. Fruits are not very nutritious, but are very good for the health. Gooseberries, strawberries, and so on, should be quite *ripe*, but not *too* ripe. Over ripe fruit is as bad as unripe. Fruits should, as a rule, be eaten during the day, and not late at night. Dried fruits should be avoided. The tart, pleasant flavour of fruits is due to the acid they contain; and this leads me to observe that vinegar in moderation helps digestion, but if taken in excess is very hurtful. It makes stout people thin, but at the expense of their health.

Eggs are very nutritious especially when poached or lightly boiled. When boiled hard or fried in fat they are difficult to digest. The same may be said of omelettes, pancakes, and fritters. Some people cannot eat the white of egg, others cannot eat the yolk. Each must find out for himself what suits him, and as Captain Cuttle says, "When found make a note of."

The last article usually eaten at a meal, and the last we shall look at to-night, is cheese, which is simply the caseine of the milk in another form. There are many varieties of cheese—skimmed milk, sweet milk, Stilton, Gloucester, and so on, but they are all good. About half of cheese is simply water, the remainder being caseine, fat aud common salt. Cheese as an article of diet is highly nutritious, but from its constipating qualities is chiefly useful in helping the digestion of other substances. For this purpose it must be old and partially mouldy, and it then acts as a kind of ferment, and causes chemical changes in the food previously swallowed. It is truly described as digesting everything but itself.

An important point is to have as much variation of diet as can conveniently be managed. The stomach loves variety, and we

all know how much more we relish our food when we have a number of dishes on the table than when we have to make our meal off one only. Peasoup every day is apt to get monotonous. Good cooking is also very essential.

How much *can* we eat ? With practice, a most wonderful quantity. Captain Parry relates that a young Esquimaux, to whom he had given for curiosity as much to eat as he liked, devoured in 24 hours 35 lbs. of various foods, including some tallow candles. A case is also known of a Hindoo, who can eat a whole sheep at a time. He would be an expensive boarder to keep !

How much *should* we eat is a most difficult question to answer. We are all notoriously in the habit of eating too much. I can give you the average amount required by active, healthy men, but the individual is not an average, and so the amount must vary more or less according to the particular requirements of each. The average man is well fed if he gets every day 4 oz. of albumen, 3 oz. of fat, 11½ oz. of starch, and about 1 oz. of suet. At the same time he must have one way or other 6 pints of water, and must breathe in 1½ lbs. of oxygen from the air, the total being about 1-20th of the weight of

the body ; but he can and does support life on less, and he certainly cannot take more without injury. He does well on half a pound of meat, 12 oz. of bread, ½ lb. potatoes, and a pint of milk.

The quantity of food required to maintain health should be varied according to the work we do. A man working very hard wastes more substance of his body than an idle man, and requires about twice as much food ; whilst a man doing a *moderate* amount of work, requires half as much more food as the man doing *none*. Then the growing youth requires quite a ruinous number of "pieces," besides his regular meals ; whilst of the old man, whose days of hard work are past, it may be said that he

> Wants but little here below,
> Nor wants that little long.

These, then, are some of the most important points connected with our Food and Drink. There are many considerations connected with such a large subject which have been left untouched, but some of these will come in more appropriately in next lecture on the process of digestion. Meantime we have seen that waste takes place continually in the body, and that this waste is repaired at the expense of the blood, which recoups itself out of the

food. We have run over the various articles of diet in common use, and if you will do me the honour of coming back to my next lecture, we shall see how the food is digested and made into blood.

No. II.

DIGESTION AND INDIGESTION.

We saw in last lecture that there is constant wear and tear going on in that complex machine, the human body; that every action, however slight, be it only the winking of an eye or the lifting of our little finger, involves the waste of tissue; and that this waste must be replaced by the food and drink we consume. As all the tissues are repaired out of the constituents of the blood, which circulates everywhere for the very purpose of supplying what is needed for the upkeep of the mechanism, it is necessary that we must restore to the blood those materials which have been lost in the course of its circulation. To this end the food we take in by the mouth must be specially prepared; and this preparation is what is known as Digestion.

The importance of a good digestion is too well known to be more than mentioned.

Without good digestion we cannot be happy, cheerful, or contented. We cannot properly play our part in life. Sorrow, from whatever source, is more lightly borne. Misfortunes seem lessened, and we look to the future as well as to the present with less gloomy anticipations when our stomachs are working well. To those whose indigestion is a continual source of gloom and fretfulness, small trifles are magnified into dire calamities, and imaginary evils have all the force of real disasters. Nor need we wonder that this is so. When we become acquainted with the admirable complexity of the apparatus on which digestion depends, when we study the process and see how intricate and yet how beautifully designed is its mechanism, our surprise is not that many of us, imprudent and reckless as we are, should suffer from indigestion, but that any of us should continue to perform the function with success seven days together.

The function of digestion, then, is to make blood, and this end is attained by a series of processes acting on the food so as to render it soluble and capable of being absorbed into the system. These processes are partly mechanical and partly chemical, and are, as we shall see, performed for the most

part simultaneously and in each organ as digestion progresses.

It is a common but quite erroneous notion that digestion is performed solely by the stomach. This is not so. The stomach certainly has a very important part to play, but we shall see that the process of digestion begins before, and is only concluded after, the food has been in that organ.

1. The first act is the prehension or taking up of food. For this the elephant uses his trunk, birds their bills, ruminants their lips, and monkeys, squirrels, &c., their hands or anterior extremities. Man, the lord of creation, uses his fingers and hands, and in polite society a fork, which, like Dr Begg's church organ, is a purely human invention.

2. Having got the food into the mouth, the next act is or should be mastication or chewing, which is entirely a mechanical operation, and is performed by the teeth. Most of us know by painful experience the troubles caused by the teeth both in coming and going, and those of us who have suffered the agony, prolonged for months and sometimes for years, caused by the cutting of a wisdom tooth, can sympathize with helpless infants during the trying period of dentition. In the process of digestion the teeth play a

most important part. By twisting the food about in the mouth, tearing and mashing it, cutting it down like a mincing machine, it is ground into small pieces, and so prepared for what is to follow. We see the importance of this in old horses whose teeth are gone. If their food were not carefully divided and bruised before being given to them, they would be doomed to certain death ! Let us, then, take care of our teeth. Regular cleansing of them, avoidance of acid medicines except through a glass tube, and taking care not to take into our mouth food which is either too hot or too cold, or worst of all, taking hot or cold drinks one after another. Although a kindly Providence has granted us two sets of teeth, the first numbering 20, and the second 32, very few people now-a-days reach the age of discretion with a full mouthful. Various explanations have been offered of this unfortunate circumstance, but none of them are quite satisfactory. One common belief is that young folks have too frequent commercial transactions with the sweetie shop. Against this view, however, we have the negro race, whose teeth, large and well developed, shine forth with alabaster whiteness from amidst the dark surroundings of their dusky skin, and yet there is no race in

all the world more inordinately fond of sugar. Another explanation is the great prevalence of smoking, and I do believe that much harm is caused to the teeth by inhaling hot tobacco "reek," saturated with juice from a well-seasoned cutty, whose stem is about half an inch long. (Moral—always keep a good stem on your pipe.) This cause, hot drinks, particularly hot tea which many people swallow in a boiling condition, and bad teeth inherited from their parents, are perhaps the true causes of the inferiority of the teeth of the present day. The high pitch to which dentists have carried the art of supplying artificial teeth, the third set as we may call them, leaves us with no excuse if we suffer from indigestion brought on by this cause.

3. Whilst the teeth are engaged mechanically grinding down the food, the glands of the mouth are busily pouring out saliva with which to soften and moisten it, and render it pulpy so as to be easily swallowed. Scattered over the lining membrane of the mouth are a number of little glands (Fig. 1) which secrete mucus to be mixed with the secretions coming from the larger glands—the parotid, submaxillary, and sublingual. Each parotid gland lies in front of the ear, and when inflamed causes the swelling in

mumps. The combined secretion of all these is the saliva or spittle. As much as 1½ lbs.

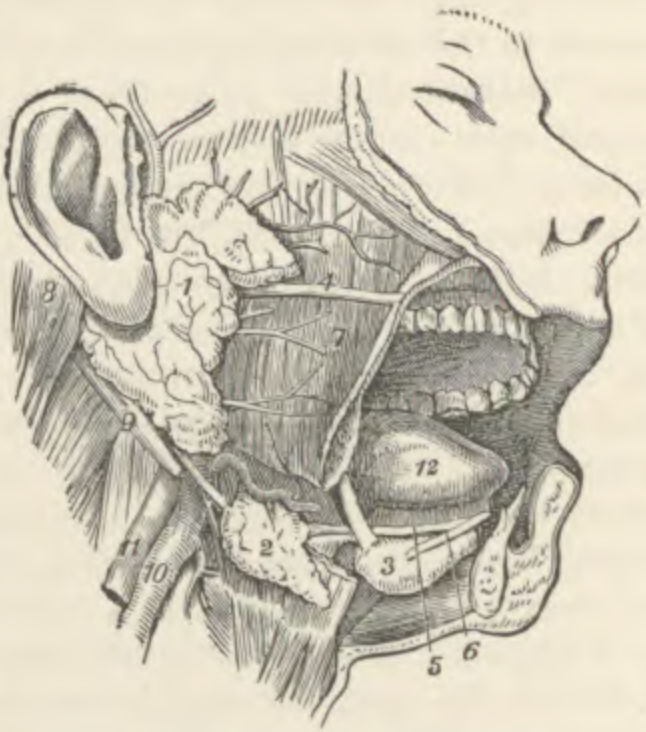

FIG. 1.—THE SALIVARY GLANDS.

1, the parotid gland; 2, the submaxillary gland; 3, the sublingual gland; 4, Steno's duct; 5, Wharton's duct; 6, Bartholin's duct; 7, Masseter muscle; 8, Mastoid process; 9, digastric muscle; 10, internal jugular vein; 11, external carotid artery; 12, the tongue.

of saliva are poured out in the 24 hours, and the stimulation afforded by the mere presence of food in the mouth is sufficient to excite its secretion. Indeed, it is very easily set going. Smoking and chewing tobacco are familiar examples, the accompanying

flow of saliva being a very unpleasant concomitant of these common practices. Continual and habitual expectoration is very hurtful; it is a very common practice amongst our American cousins, and is not wholly unknown, to say the least of it, amongst ourselves. The elegantly traced designs on the pavement at the Cross and other corners of our streets are unsavoury witnesses of this. Again, the mere thought of food or the sight of tempting viands are enough to make one's mouth "water."

Besides having the mechanical effect of softening the food, and that is its principal use, the insalivation has a chemical action. It transforms some of the starchy food into sugar, and this transformation is greatly assisted by the previous cooking the food has undergone. Boil a potato, which is starch and water, and the little starch cells are burst by the heat, so that the saliva gets at them and converts them into sugar. You must all have noticed how sweet a potato tastes after it is well masticated.

Chew your food well, and take plenty of time over it. Eating too fast is a very common cause of indigestion, for the food must be rubbed down somehow, and if not in the mouth, then in the stomach, which

has enough to do without that. Many people bolt their food in total ignorance of the harm they are doing, and quite forgetting the old adage that prayer and provender hinder no man. So if any of you are *bolters*, form a determination at once to eat slowly. Cheerful and entertaining conversation is a great help in this matter; and the lonely bachelor, who has no one to talk to, may read his newspaper, a practice so rude and objectionable in the presence of a second party, that I am sure no married man would even think of adopting it. Toothless persons and quick eaters will do well to have their food minced very small before eating it. Infants secrete no saliva till they are getting teeth, and hence should never be fed on farinaceous foods before they are six months old. These simply pass down into the stomach in hard undigested lumps, and may produce very serious results.

It is in the mouth, tongue, and palate that little nerves are scattered which convey impressions of taste.

That, then, is what takes place in the mouth. The food is ground down, softened with saliva, and part of the starch converted into sugar; and the next thing we do is to swallow our food, which is called deglutition.

4. The food is passed along the back of the tongue, passing over the entrance to the windpipe, which is closed by a valve to prevent our swallowing the wrong way. It is also prevented from coming back down the nose by the closure of the communication there, and so it passes into the gullet, the muscular contractions of which send it on to the stomach. Food does not fall down the throat by its own weight. The muscles of the gullet contract on it, and drive it on in successive waves, as you may easily see when a horse is drinking water with his head lower than his body ; and in circuses we often see the clown drinking a glass of water whilst standing on his head.

Although swallowing is usually easily performed, and that, too, without our knowing anything about it, it sometimes happens that from the attempt being made to swallow too large a piece of beef it sticks on the way, and causes death by pressing on the air passage. Again, a pointed article such as a fish bone may get caught. If any of you happen to be present when any such catastrophe occurs, keep your presence of mind, boldly place the sufferer's head well back, and put your finger down his throat. Very likely you will be able to hook out the piece

of beef. If you cannot feel it from it being too far down, there is not much fear of immediate danger, and you have time to send for assistance. It is wonderful what large articles can be swallowed with safety. Many of you have doubtless seen the juggler swallow his sword; and there are many instances of persons having swallowed and passed through the whole intestinal tract such articles as coins, clasp knives, and even sets of false teeth. Here is a screw nail swallowed by a little boy a few weeks ago, and passed in two days without an unpleasant symptom. You may ask what should be done on such an occurrence happening as any of your children swallowing coins, buttons, or slate pencil, or such like. Well, do *not* give medicine: feed the child for a few days entirely on sago, arrowroot, porridge, and rice and milk, and ten to one you will have the gratification of soon recovering that which was lost. At the same time call in your medical attendant, as such cases do sometimes end fatally. The most extraordinary case on record is one where a fish jumped down a man's throat when bathing.

5. The food reaches the stomach in a state of pulp, with a slight chemical change in

its starchy contents, and here it is acted on by the gastric juice. It may interest you to know that the information we possess concerning what goes on in the stomach is not mere supposition. We have derived most accurate data owing to a fortunate accident, fortunate for science I mean, which befell the Canadian, Alexis St Martin, who had a large hole opening into his stomach, caused by the discharge of a gun. The wound healed, but the opening remained, and his attendant, Dr Beaumont, utilized it for observation and experiment. He used to pop in pieces of meat with a bit of string attached to them, and pull them out now and then to see how they were getting on. He also shoved in a thermometer every little while to see how warm his stomach was, and other little experiments of that kind.*

The stomach of man (Figs. 2 and 3) is an elongated curved pouch, having the form of a bagpipe. It holds on the average when fully distended 5 pints, but with practice it can be made to stretch considerably larger. When the body is fasting, the lining walls of the stomach are pale and flabby, and lie

* St Martin died only last year over seventy years of age, so that Dr Beaumont's experiments do not seem to have interfered with the longevity of this celebrated man.—W. W.

close together, but the arrival of food changes this condition. As the food is forced in, the stomach distends and increases in size with each accession of provender. Gradually the distension becomes more and more difficult, and this creates a sense of fulness which warns us to stop eating. The lining membrane of the stomach is a continuation of that which commences at the mouth where the skin terminates and extends throughout the entire length of the intestinal tract. Underneath this mucous membrane in the stomach are two muscular coats. The food acts as a stimulus, and the muscles contract and send the food moving round the stomach in the direction indicated here.

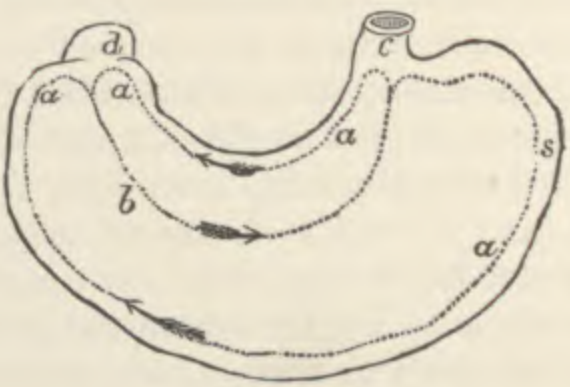

FIG. 2.

Showing the general direction of movement impressed on the semifluid food in the stomach.

a a, the surface current, carrying the food to the closed pylorus, where it is reflected into *b*, the central current which unites the cardiac *(c)* and pyloric *(d)* openings.

The revolutions are completed in from one to three minutes each, and continue till the

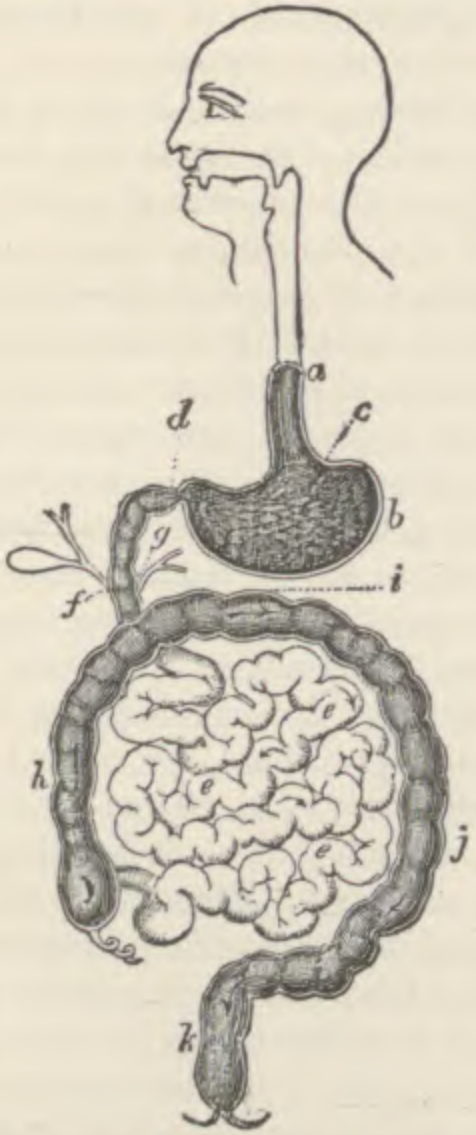

FIG. 3.—HUMAN ALIMENTARY CANAL.

a, œsophagus or gullet; *b*, stomach; *c*, the cardiac orifice; *d*, the pylorus; *e*, small intestine; *f*, biliary duct; *g*, pancreatic duct; *h*, ascending colon; *i*, transverse colon; *j*, descending colon; *k*, rectum.

food is thoroughly acted on by the gastric juice. Whilst this movement is going on the two openings out of the stomach are closed, so that the contents cannot escape. By this churning, any food which was imperfectly masticated in the mouth is reduced to pulp, but at the expense of extra work on the part of the stomach, so that we now see the importance of properly chewing and insalivating our fodder before swallowing it.

Whilst this mechanical action is proceeding, we have at the same time the chemical action. In the mucous membrane lining the stomach are crowds of minute finger-shaped tubes, the gastric follicles or secreting glands from which the gastric juice is poured into the cavity of the stomach, directly the membrane is irritated by the presence of food, or indeed of any other substance. 10 to 20 pints or 31 lbs. daily are secreted from these glands in a healthy grown man. When the food stimulates the glands, the gastric juice stands out in drops and then trickles down the walls of the stomach just like sweat on a man's face. Besides this gastric juice there is also present a secretion of mucus from the membrane, and in addition to these we are always swallowing saliva or spittle. The gastric juice is

composed of hydrochloric and lactic acids, and a peculiar substance called pepsin. It acts chemically on meats, oatmeal, fish, eggs, bread, and all other albuminous substances, converting them into *peptones*. Nothing much is done to the two great classes—the sugars and the fats. The cane sugar is converted into grape sugar, and sometimes fatty acids are developed from the fats; but there is more to be done further on, so that we see we must not regard the stomach as being the only organ of digestion. Gastric juice has the property of arresting the putrefaction of other organic substances, and it is to this that we owe the impunity with which we eat high game and mouldy cheese. It is a curious circumstance that although fats are not acted on by the gastric juice their presence assists the digestion of albuminous substances, hence it is a good plan to eat ham or bacon along with chicken, and butter with our bread.

The function of the gastric juice, then, is to dissolve albuminous substances. Now, the stomach itself is an albuminous substance; in fact, is simple *tripe*. Why, then, is the stomach not also dissolved? The answer to this curious question is, I think, this: There is no gastric juice in an empty stomach, and

when food is present the gastric juice of course acts on it. Still it does to some extent dissolve the coats of the stomach, but they are so quickly repaired that no damage is done.

The gastric juice being so essential to stomachic digestion, it will be easily understood that when deficient in quantity the process is interfered with. It is also clear that when we pack the stomach too full the muscular action cannot well move the mass round and round, and digestion will proceed very slowly. Often the stomach will relieve itself by relaxing its cardiac orifice (Fig. 3, *c*), contracting strongly with the help of the neighbouring muscles, and get rid of the surplus by vomiting. It telegraphs to the brain that "too much food has been swallowed." Brain telegraphs back, "Vomit it." Infants vomit with great ease because their stomachs are more perpendicular. At other times the stomach gets tired attempting to digest what is beyond its powers, and passes the entire mass into the intestines—it may be to cause great mischief there.

To return to the food. It goes moving round and round, getting softened and liquefied, and as each portion becomes ready it is passed through the pylorus (Fig. 3, *d*),

that is the communication between the stomach and bowel into the intestine (Fig. 3, *e*). The pylorus corresponds to that part which is generally referred to as the pit of the stomach, and undue pressure on this is a fertile cause of indigestion. The faulty position of children at school who rest on the edges of writing desks is very hurtful, and tailors and shoemakers who are obliged by their calling to have the trunk always bent forward are liable to very painful forms of dyspepsia. Through the pylorus, then, are passed the softened masses of food, and after a time the whole remaining contents of the stomach. If any solid substance has been swallowed such as a coin or a nail, it passes through also, although cases have been known in which the foreign body has stuck fast. A fork swallowed by a Parisian clerk in 1874 was unable to pass, and had to be cut out. Five shilling pieces have passed without inconvenience, and London thieves are well known to have swallowed articles to escape detection without bad results to themselves. I do not, however, advise any experiments of this kind!

It is difficult to fix the period of time occupied by the stomach digestion—it depends

so much on the nature of the food, the energy of the contractions of the stomach, and the activity of the secretion of gastric juice. It is estimated that its duration is about three hours, but this will vary greatly according to circumstances. Taking too much cold water and thus lowering the temperature of the stomach retards the process; hence the practice of eating ice after dinner is very prejudicial. Then the effect of the emotions on digestion are well known. Pleasant society and cheerful conversation assist, whilst bad news or a fit of anger are sufficient to arrest it altogether. Violent exercise after eating is bad if within an hour, but later if taken gently it rather helps. Hence working-men should not live too far from their work as they should have some time to rest after eating. Dr Beaumont ascertained the length of time required for the stomach to digest certain articles of meat, and having Alexis St Martin to experiment on was able to collect some very interesting facts. He found that the flesh of wild animals is more easily digested than that of our domesticated ones, owing to the former containing less fat, which we saw is not acted on by the stomach. Beef is more speedily reduced than mutton, and mutton

sooner than either veal or pork. Fowls are far from possessing the digestibility attributed to them, but turkey is, with the exception of venison, the most soluble. Tripe is digested in about an hour.

We are now done with the stomach, and must proceed to see what takes place in the intestines.

We have seen that in the stomach the food is churned, mashed up and softened, that the fats are not much changed except that they are more oily, that the sugars are little altered, and that the vegetables have been made pulpy, but otherwise are as they were. The albuminous matters have alone been chemically acted on, and are become peptones. The entire mass, as it leaves the stomach, is called chyme, and resembles peasoup. The intestinal canal (Fig. 3) is upwards of 30 feet in length, and, like everything else in this wonderful body of ours, is packed away into very little space. Coiled round and round, it is little wonder, but the reverse, that it sometimes gets tied in knots causing *iliac passion*, or protrudes through the abdominal wall causing *rupture*. In this canal digestion is completed by the help of the secretion from the pancreas or sweetbread, the bile from the liver, and

secretions poured out from the intestines themselves.

FIG. 4.

Small intestine laid open to show the folds by which its surface is greatly increased.

FIG. 5.

The nnder surface of the stomach and liver.

St, stomach, *p*, its pyloric end; *l*, liver; *g*, gall-bladder; *d*, duodeuum, extending from the pyloric end of the stomach to the front, where the superior mesenteric artery *(sm)* crosses the intestines; *pa* pancreas; *sp*, spleen; *a*, abdominal aorta.

1. The secretion from the pancreas (Fig. 5, *pa*), resembles the saliva of the mouth, and as we might therefore expect is intended to finish the digestion of the starchy materials, and in addition to make the fatty matters into an emulsion. You will see Pancreatic Emulsion largely advertised at present, and it is indeed a most valuable remedy in cases where a deficiency of this secretion is the cause of dyspepsia.

2. The secretion from the liver (Fig. 5, *l*), as you are all aware, some of you perhaps painfully aware, is the bile. No less than 3 or 4 lbs. are daily poured into the intestine, which is its proper sphere. If from any cause it has risen into the stomach, as unhappily it sometimes does, we are seized with nausea and vomiting, and digestion is at once arrested. We may have taken unsuitable food, or have overloaded the stomach, so that it cannot get through its work, the bile flows back into the stomach, and we are said to have a *bilious attack*. The sphere of the bile is in the intestines, and it has no business in the stomach. A bull may be well enough in his proper place, but in a china shop he plays mischief.

Again, the duct which conveys the bile from the liver into the bowel may get blocked

up from the presence of a gall stone, or from the pressure of a tumour, or of tight stays. Finding no outlet, it accumulates in the blood, and we have *jaundice.*

What is the use of the bile? In the first place, it is manufactured out of the impurities of the blood, as that fluid flows through the liver, so that it purifies the blood. Second, it helps to make the fatty part of the food more easily absorbed. Third, it helps to keep down the undue formation of flatulence. Fourth, it stimulates the coats of the bowels to act, and so may be regarded as a natural aperient.

The intestinal juices continue and complete the process of digestion, so that nothing of a nutritious and suitable nature can escape.

Digestion is now nearly completed; the food consisting of refuse, and of good nutritive material known as *chyle.*

But were there nothing more, all this complicated process would be of no avail. The body would be like a thirsty man standing by a deep well and having no vessel wherewith to draw water. The food is still to all intents and purposes out of the body.

But there is more. There are all along the

intestines little projections, (Fig. 5, *a*, and Fig. 6),

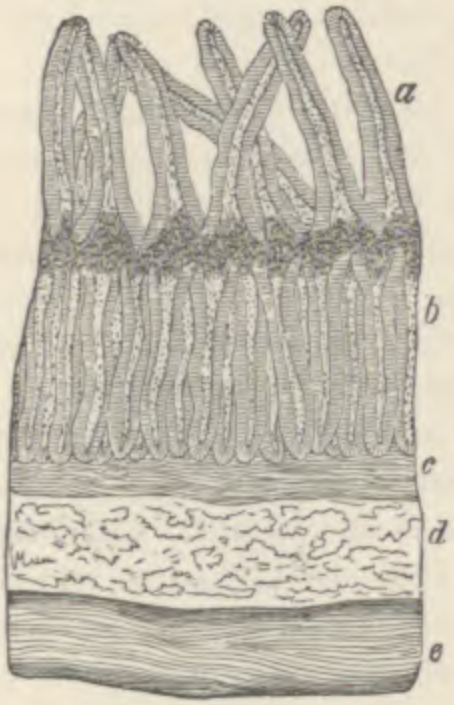

FIG. 6.

Vertical and longitudinal section of small intestine showing its coats.

a, villi ; *b*, intestinal tubes ; *c*, areolar tissue ; *d*, muscular fibres ; *e*, longitudinal muscular fibres.

little fingers, which pick out and seize all the good parts of the food as it passes by. These little fingers are not open, however ; they are closed tubes. How does the food get into them ? To make this plain, I show you a bladder filled with a fluid. You see it does

not leak. If I put it into a jar of water, the water will penetrate the membrane, and the fluid will flow out at the tube, because the bladder is too full. This happens in the body. Fluids of different densities pass out and in through the coats of the vessels. This process is called Osmosis, and this is how the food goes through the little tubes hanging there for the purpose of absorption.

The liquid part of the food was to a slight extent absorbed in the stomach; but the most part is taken up as it passes along the small intestine. Part of the food thus absorbed is passed into the veins and sent to the liver, the custom-house, which refuses to pass certain elements injurious to the body, but allows the remainder to return to the heart. The other part of the food is passed into a long tube which passes up the body behind the gullet, and empties into a vein on the left side of the chest, so that the two portions meet in the heart. The united current is then sent to the lungs to receive oxygen from the air, and becomes good, useful, bright arterial blood, fit for building up the tissues of the body, and repairing that waste to which I referred at the beginning of this lecture.

The refuse—by which I mean that portion of the food we have swallowed which is un-

FIG. 7.

Two villi with the lacteal vessels in their interior. *a*, membrane of the villus; *b*, basis of the same; *c*, dilated blind extremity of the central lacteal; *d*, trunk of the same. Real size, 1-45th of an inch in length.

suitable or not required—is passed, along with surplus of bile and other secretions, into the large intestine (Fig. 8), and so thrown out of the body (Fig. 3, *k*). I think I may here be allowed to make a remark on the frequent taking of aperient medicine. We

are certainly improving on this point. People do not now-a-days dose themselves and their children so copiously as was formerly the case, when the common result was chronic inflammation of the intestines from the continual irritation; and we are far removed from the time when one of the physicians of Louis XIV. inflicted on that unfortunate monarch in a single year 215 potions. When medicine is really required, and it is import-

FIG. 8.

Point of union between small and large intestines.

a, termination of the ileum; *b*, ascending colon; *c*, cœcum; *d*, a transverse construction projecting into the cœcum; *ef*, lips of the valve separating the small from the large intestine; *g*, the vermiform appendix of the cœcum.

ant to pay attention towards the maintaining of what Josh Billings calls a "reliable set of bowels," endeavour to attain your object by diet and exercise—fruit in its season, oranges taken fasting in the morning, and plenty of fresh air at all times.

All the phenomena which have been examined take place when the whole digestive canal is in good working order. The process being of great complexity, and each step being dependant on all the others, it can easily happen that some little derangement of function in some of the organs concerned may lead to indigestion in some of its many forms.

Patient and long-suffering are our digestions. There is no organ of the body more abused and insulted than our stomach, and no organ which stands abuse so long. We may go on for a time over-loading it with heaps of indigestible rubbish, scalding its coats with boiling tea, burning it up with strong drink; we may never give it a rest. Hardly has it time to get through a third of the food we have rashly packed in its interior than down we send another cargo and expect that we shall hear no more about it. Nor do we for a time. At first the healthy stomach will go through prodigious feats of work. The

growing child will eat his regular meals, and will demand a "piece" at frequent intervals besides; and such is the power of the youthful digestion that he will do this for the most part with impunity, if the food he gets be wholesome and digestible; but the adult cannot take liberties of this kind for very long before the long-suffering digestion rebels, and he will be a martyr to dyspepsia for the rest of his days. A miserable being is the confirmed dyspeptic. Every mouthful he eats is a source of anxiety to him; he cannot take supper without the dreadful anticipation of nightmare; the state of his stomach influences his temper and his affections, and the irritable state of his nerves makes him take the most gloomy view of his prospects both in this world and the next.

All forms of indigestion finally resolve themselves into excess or deficiency of the secretions which we saw played so important a part, but the mechanical part of the work when hastily or badly performed has, by not preparing the food properly for the secretions to act upon, a large share in the production of dyspepsia.

The symptoms of indigestion are various, both in their nature and in their severity: one individual suffering severely when his

dinner disagrees with him, while another has merely slight depression. But in the chronic cases there are usually loss of appetite, a sensation of pain, weight and fulness at the stomach, flatulence, or the undue formation and collection of gas in the intestinal canal; foul breath, furred tongue, nausea and vomiting, acidity, palpitation of the heart, heartburn, cramp in the stomach, and water brash. The mental effects produced by gastric irritation vary from slight dejection and ill-humour to the most extreme melancholy, the latter even sometimes inducing a disposition to suicide. (Tanner.) Sydney Smith gives the following humorous description of an attack of indigestion :—"The longer I live," says the rev. wit, "the more I am convinced that half the unhappiness in the world proceeds from little stoppages, from a duct choked up, or from food pressing in the wrong place. The deception as practised upon human creatures is curious and entertaining. My friend sups late; he eats some strong soup, then a lobster, then some tart, and he dilutes these esculent varieties with wine. The next day I call upon him. He is going to sell his house in London and to retire into the country. He is alarmed for his eldest daughter's health. His ex-

penses are hourly increasing, and nothing but a timely retreat can save him from ruin. All this is the lobster, and when over-excited nature has had time to manage this testaceous substance, the daughter recovers, the finances are in good order, and every rural idea effectually excluded from the mind. In the same manner," says he, "old friendships are destroyed by toasted cheese, and hard salted meat has led to breach of promise of marriage."

Indigestion is sometimes connected with organic disease of the liver, stomach, or pancreas, but I do not propose saying anything about that kind, as these are secondary complications dependent on other diseases. All I wish to do is to point out some considerations by which we may avoid the preventible forms of indigestion.

Whilst examining the process of digestion, I have already had occasion to notice some circumstances which have a most important influence on its due performance. *Eating too fast* is one of these, and I can only again caution you all against this very common habit. If you value your health eat slowly.

Ill selected food is a fertile source of dyspepsia. In last lecture we examined the different kinds of food, but I may here

repeat that when any individual finds a certain eatable disagree with him every time he takes it, he ought to forswear that for ever. Each man must be a law to himself, for it is impossible to lay down any hard and fast rule which will apply to all; but so important is it to supply our bodies with what our experience has taught us to be suitable that we may all pray with Solomon of old—

> "Give me neither poverty nor riches;
> Feed me with food convenient for me."

Over-eating is another mistake. The stomach to do its work properly requires to be distended to a *certain* extent. We must have some *bulk*. The Kamschatdales, for example, are in the habit of mixing earth or sawdust with the train oil on which alone they are frequently reduced to live, and the wild hunters of Ceylon mingle the pounded fibres of soft and decayed wood with the honey on which they feed when meat is not to be had. (Carpenter.) This is a very different thing, however, from packing the stomach so full that a state of matters is produced, which I lately heard of in a little child who seemed in great distress after a full meal, and who could only explain in that infantile jargon so unintelligible to everybody but

themselves, that she was "awfu' ikey buss." The anxious but bewildered mamma was quite at a loss till an older child acted as interpreter, and explained that she was saying "she was awful like to burst." The stomach may not burst, but it is certainly unable to revolve such a mass without a prodigious effort, which, if frequently repeated, weakens the muscular coat, and one of the most intractable forms of indigestion is the result. Therefore stop eating before you feel full.

Good cooking is very helpful to digestion, not only by properly preparing the food, but by giving a pleasant flavour, stimulating the secretion of saliva and gastric juice. Bad cooking, on the other hand, is responsible for much of the poor digestion that prevails. Porridge insufficiently stirred and boiled so as thoroughly to burst the starch cells, meat over-boiled, roast beef cooked like leather and all the albuminous juices gone, and pastry which would pass for dough, have all much to answer for.

To roast beef properly, it ought to be placed before a very quick fire so as to congeal the outside albumen and prevent the juice escaping, and then cooked before a slower heat till the entire roast is done

throughout. On the same principle, to boil beef or mutton, it should be placed in boiling water at once; but if you wish to make soup place it in quite cold water, and gradually heat it. After all the juices are gone, the fibre is of no value for food. Frying is a mode of cooking which ought to be abolished.

Avoid Eating between Meals. None of you would like to be asked to go on working all night or on Saturday afternoons in addition to your regular work, and yet many people expect their digestion to go on without any rest! Regularity in eating is most important, and regularity of intervals particularly so—four or five hours should generally be allowed to intervene between meals. If you dine late you require no supper, and if you have a good tea at six or seven o'clock you want nothing till next morning.

Fresh air and exercise are very important. When the liver is out of order, forming too much or too little bile, and causing diarrhœa or vomiting, a good walk, a round of the Links at St Andrews, or open air games of any kind will frequently set matters right. Those leading sedentary lives should particularly attend to this. I can count on my fingers the merchants who make a point of having a daily walk in the neighbourhood.

Why do they not all do so? Young people employed in shops, especially sewing girls who have to sit all day, millworkers toiling in an atmosphere loaded with dust, lawyers of whom Cupar has its share, and their clerks engaged all day with doughty deeds, and clergymen composing their exhortations for the Sunday's appeal, cannot enjoy good digestive powers unless they make a point of having regular exercise in the open air.

With the short hours now enjoyed, and deservedly enjoyed, by nearly all classes of working men, there is abundant time for the daily walk or the daily tidying of the garden which most of us in Cupar possess.

With the excellent footpaths on most of the roads around the burgh, with the magnificent views to be had from such places as the Garlie Bank, we ought to be famed as pedestrians; and the young ladies of Cupar will perhaps pardon an old friend if I suggest that a smart walk to Carslogie or the Four Lairds' Lands, varied with an occasional ascent of the Moathill, will prove more expansive to the intellect and less trying to the boots than a dreary promenade of the Crossgate.

The extensive use of bicycles and tricycles by all classes of the community has done

much good in the way of improving the appetites and promoting the digestive powers of many; and a most favourable comparison can be drawn between a health-giving spin of an hour or two's duration in the free air of the country and the slow stewing undergone in the heated and smoke-laden atmosphere of the billiard-room.

Take exercise freely—lawn tennis, cricket, football, golf, anything that keeps your body moving and your brain working; anything that makes the blood circulate and feeds the lungs with oxygen; and a sound digestion will be your reward.

The influence of the Nervous System is very prominently manifested on the digestive process. The brain workers are particularly subject to dyspepsia, due, perhaps, in some measure to their leading sedentary lives, but chiefly due to the nature of the work they do, for brain tissue is a terribly expensive one to use. Our emotions, too, are destroying flames. Anger, despair, sorrow, and even joy, interfere greatly with a meal, and are capable of rendering what is swallowed incapable of being digested. The small troubles of which life is made up, the anxious cares of business, the hopes, the fears, and the disappointments, with which

we are all more or less familiar, have a great effect on our digestions. And here is a useful lesson. When we are requiring food, when the alimentary canal is ready to digest, we are hungry. When overwhelmed with despair, when Death—the universal tax-gatherer—has visited our home, has removed one of our loved ones and left us prostrate with grief, then, indeed, does appetite depart and we feed on our sorrow alone. Sympathising friends may insist, with well-meant but mistaken kindness, on our eating a morsel, just a mouthful, to keep up our strength, but it is most unreasonable to expect the stomach to do its work under such circumstances as these. Fortunate, on the other hand, but surely rare, is the man who in the midst of his grief feels that he must eat. In such a case he should certainly satisfy the instinct of hunger, and no sentimental fear of appearing unfeeling should interfere with the appeasing of his appetite.

A common cause of indigestion is deficiency of gastric juice or of some of the other secretions, and many people instinctively remedy this condition by the use of spices. These should be sparingly used, however.

With the newly brought out preparations of the digestive ferments, liquor pepticus,

and liquor pancreaticus, many forms of dyspepsia due to defective secretion can now be cured, and in a more natural manner than by the use of spices, such as mustard, chutney, Worcester, and all the other sauces which are so commonly used to give a relish to the food.

I conceive that it is for some such reason as this that smoking tobacco after meals assists digestion; for whatever produces increase of saliva, causes an increased flow of gastric juice at the same time. Any smoker, and I do not doubt there are one or two present, will tell you that the most enjoyable smoke is the one taken just after eating. A whole lecture might be delivered on the subject of tobacco, and as I have been requested to say something about smoking, it may be interesting now to run over some of the considerations regarding it.

Tobacco is manufactured from the leaf of a plant, the nicotianum tobacum, a specimen of which I have here. Columbus found smoking a common practice amongst the American Indians, with whom it partakes of the character of a religious observance. It is connected with their worship, and with all their important transactions. Thus the calumet or pipe of peace is indispensable to

the ratification of a treaty, and smoking together has even greater significance of friendship than eating together has amongst other nations; and even amongst ourselves every smoker knows how much more friendly he becomes in the presence of a fellow smoker than with one who does not smoke! It was not until the 16th century that the custom of smoking was introduced into this country, and it had then to fight its way against many difficulties. For instance, Sir Walter Raleigh was on one occasion having a quiet pipe when a servant came upon him, and seeing the smoke issue from his mouth concluded he was on fire, and immediately threw a jug of ale over him to put him out; and I lately heard of a somewhat similar misconception where a country child, seeing a bicyclist go past with a pipe in his mouth, drew the conclusion that he was a chimney, and that the machine worked by steam.

Against the use of tobacco, Popes, Priests, and Sultans, fulminated in vain. In Turkey the pipes of smokers were thrust through their noses, and in Russia the noses of smokers were cut off in the early part of the 17th century. King James the First of England issued a counterblaste to tobacco, one passage of which is as follows:—"Surely

smoke becomes a kitchen farre better than a dining chamber ; and yet it makes a kitchen often times in the inward parts of men, soyling and infecting them with an unctuous and ugly kind of soote as hath been found in some great tobacco-takers, that after death were opened. A custom loathsome to the eye, harmful to the brain, dangerous to the lungs, and in the black stinking fume thereof nearest resembling the horrible Stygian smoke of the pit that is bottomless."

Notwithstanding all this, however, the custom continued to spread until it is now exceedingly common in every known country. We annually import about 80 million lbs., which pays 8 millions to the revenue.

In tobacco smoke there is a certain amount of watery vapour, a small quantity of pure carbon which gives the blue colour to the smoke, and a certain quantity of ammonia. It is the ammonia which bites the tongue after long smoking, and which makes the tongue and throat of the smoker so dry and makes him drink as he smokes. There is always present carbonic acid, which is the cause of the sleepiness, headache, and lassitude which follow the prolonged inhalation of tobacco fumes.

Tobacco smoke also yields a poisonous oil—

the oil of tobacco—which contains nicotine, a volatile substance having a peculiar odour, and an extract having a bitter taste. The peculiar smell of stale tobacco smoke which hangs so long on the breath and on articles of clothing is derived from the volatile substance, and the nauseous sharp taste felt on taking a foul pipe into the mouth is due to the bitter extract.

The nicotine is exceedingly poisonous, one drop being sufficient to kill a dog; and as every smoker inhales more or less of it, it is easy to understand that smoking must be most injurious to the young. Before the full maturity of the system is attained even the smallest amount of smoking is hurtful, but in mature years it is pretty well established that it is only prejudicial when carried to excess.

The kind of pipe used has an important influence on the effects produced; a long clean pipe of clay or meerschaum, which can suck up the oily matter before it reaches the mouth, is always to be preferred—short cutties, well seasoned as it is called, are very bad. Briar roots absorb a good deal of the oil, and are especially useful in this way when they have a chamber into which the oil drops. If there be any smokers present I

must beg them to clean out their pipes frequently and to keep their consumption of tobacco as low as they possibly can, and to remember that smoking in the open air is not so injurious as in a room or railway carriage. Never smoke in the presence of a lady, even if she is only your wife. However much the dear creatures may protest "that they rather like it," and "that it is such a fragrant smell," they one and all abominate the practice most heartily.

Cigarettes and cigars, unless they are smoked with a long mouthpiece, are more hurtful than a moderately clean pipe. It is not easy to lay down the law as to what is excess in smoking. When the smoker finds his eyesight affected, and his hand unsteady, when he has palpitation of the heart, nervous twitchings, or sore throat, he may know that he is smoking too much, and if he be a wise man, will at once give it up altogether, or curtail the amount he consumes, when the bad effects will very soon disappear.

As regards the effect of smoking on the process of digestion, we have already seen that the hot smoke injures the teeth; but that, on the other hand, smoking after a meal increases the secretion of gastic juice, and is thus rather beneficial than otherwise.

Hence the folly of smoking just before meals and in the intervals. Many smokers have their pipes in their mouths the first thing in the morning, and the consequence is that when breakfast time comes the gastric juice has been greatly wasted, and the appetite is not so good as it would have been, nor the food taken so well digested. Washing out the mouth with Condy's fluid destroys smell.

More hurtful to the digestion than tobacco is alcohol. Persons of weak digestion find some aid from small quantities of spirits taken along with, or very shortly after, food. The alcohol causes an increase of the gastric juice, and the digestion is therefore more easily performed. The good effect, however, is only produced if the spirits be well diluted with water; if taken neat, the opposite effect is produced—the mucous membrane is dried up. Of the effects of alcohol on the digestive organs when taken in excess it is unnecessary to speak. A chronic inflammation of the mucous coat of the stomach and disease of the liver are the penalties of over-indulgence; but I do think that Cupar, though not perfect in every respect, is a comparatively sober and temperate town.

A fair conclusion to draw from observation and experience is, I think, that old people—

weakly ones, whose hold of life is but slight —are the better of stimulants in small doses along with food; that strong, hearty, healthy folks do not *require* any help from alcohol; and that the young growing frame can derive nothing but harm from its use.

Such, then, is the process of Digestion, which is merely a preparation of the food into a liquid capable of restoring strength to the blood. In next lecture we shall see how the blood circulates through the system and maintains the fabric in repair. Meantime, some of the considerations I have referred to may be of service in keeping your digestive system in good working order. Eat slowly, don't eat too much, be careful *what* you eat, have it well cooked, eat regularly and not between meals, have plenty of fresh air and exercise; ca' canny with spices, drink, and tobacco, and you will find that "good digestion will wait on appetite."

No. III.

CIRCULATION OF THE BLOOD.

In the two previous lectures, it has been pointed out that the object of taking and digesting food is to make blood, from which the various tissues of the body may repair that waste which is continually going on, and we must now inquire how the blood effects this work.

Every part of the body as it wears away repairs itself from the blood as it passes by, so that it is needless to say that the blood contains and carries away with it everything that can possibly be required.

You are all familiar with the appearance of blood, which seems to be merely a red thick-looking fluid, and which certainly does not strike one as being so complex and important a constituent of one's body as it really is; and yet that simple looking fluid contains—lime, common salt, water, oxygen, carbonic

acid, phosphorus, &c., in short, all the elements of which the body is composed.

It will serve our purpose to-night to describe the blood as being composed of a liquid, the liquor sanguinis, and an immense number of little bodies or globules, the blood corpuscles, of two kinds, the red and the white, the latter being in the proportion of two or three to 1000 of the red. It is not very well known what the white corpuscles are for, but we know a good deal about the red ones. On the diagram here,

FIG. 9.
Blood corpuscles highly magnified.

we see these very highly magnified, their real size being 1-3200ths of an inch each. They have a great tendency to turn on their sides and run into bundles like piles of coin, and they have a remarkable power of absorbing

oxygen and giving out carbonic acid gases. They are so numerous that 5000 of them could be placed on the point of a pin, and in a small drop of blood there are something like three millions of them. As many as 20 millions perish every second. We are not to suppose, however, that they *alone* convey nourishment to the various tissues. The fluid in which they float does a great deal in that way, too. Indeed, they are both composed of nearly the same elements, although in different proportions, the iron of the corpuscles being replaced by the albumen of the fluid which also contains most of the common salt.

The fluid part of the blood has the peculiarity of coagulating when out of the body. If you draw fresh blood, and let it stand at rest, you will find that it separates into a clear fluid, and into a clot, which somewhat resembles liver. This explains the remarkable statement of the old lady who was seized with a vomiting of blood, and in ignorance of the secure way in which the liver is moored, declared that she had certainly brought up that organ.

Such, then, is the blood—a liquid having floating in it innumerable little corpuscles.

The quanity of blood in the human body is estimated at from 12 to 16 lbs.

In order to nourish the different parts of the body, it is necessary that the blood should go back and forward—to and fro—carrying supplies. And so it does. It circulates throughout the entire body, and each part helps itself to what it requires as it passes by.

The City of Venice furnishes an excellent illustration of the mode in which this is done. You all know—travelling panoramas have made us familiar from childhood with the fact—that the streets of Venice are one mass of canals crossing and recrossing each other. Instead of taking a cab, you take a gondola, and instead of having your provisions sent home in the butcher's cart or the baker's van, a boat calls at your door and leaves what you may happen to require in the way of food. The canal also takes away all the refuse you have occasion to get rid of, thus answering the two purposes of carrier and scavenger. In the same way a vast number of boats, laden with rich nutritious provender of every description that can possibly be required, leave the heart every second—some are only going a very little distance, others are going further on, whilst others again have to go all the way to the points of the toes. In this they resemble the bands

of postmen and policemen, whom you may see in a large town leave the head office in a body—one goes down this street, another goes up that, and so on, till each man has reached the sphere of his work. But to keep to the illustration of the boats. Each little boat having arrived at its destination unloads its cargo, receives in exchange the refuse, and travels back by another canal to the heart, and then to the lung, where it empties out its rubbish, receives a fresh cargo, and sails along to the heart to be again sent on its career. These little boats are like other little boats, subject to wear and tear, but they are from time to time renewed by the food we digest, so that in health there are always plenty of them to do the work required.

Iron is an important part of them, and the taking of steel drops or other preparations of iron is found to increase their number greatly.

Our knowledge of the fact that the blood circulates at all is of quite recent origin. The ancients imagined that the arteries and veins were filled with air ; and even after it was discovered that there was fluid there, it was not suspected that that fluid went round and throughout the body. In 1628 William

Harvey, the son of an English yeoman, published his celebrated work, setting forth his discovery of the circulation of the blood which he had made nine or ten years before. It seems surprising that nobody ever thought of what to us seems so very obvious an arrangement; but this may be said of all discoveries, and Harvey's name will assuredly be honoured and revered as long as the world lasts.

Even Harvey, however, did not make out how the blood passed from the outward bound canals (the arteries) into the homeward bound canals (the veins). The little harbours (the capillaries) joining these two could not be seen, as they had no microscopes in these days, and they are far too minute to be seen with the naked eye.

The circulation of the blood is in reality a double one—a larger circulation and a smaller one—the centre of each and the moving power of each being the heart, and the heart accordingly is in reality two hearts joined together.

Here is an ideal scheme of circulation which will make plain what I mean. We shall start at the left side of the heart (*v'*),

which is contracting at this moment, we will suppose.

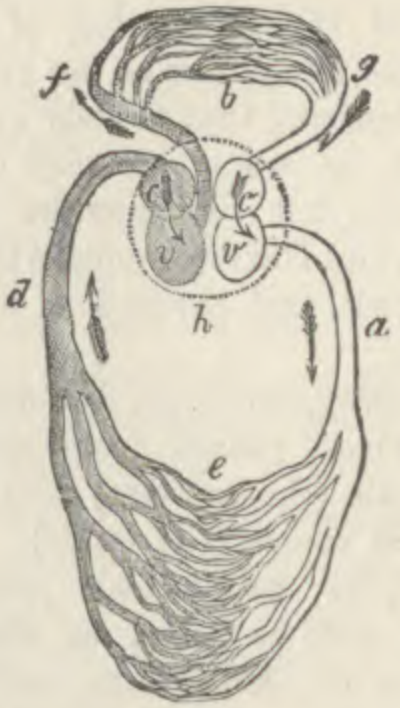

FIG. 10.

Mode of circulation in man and other mammals and in birds—*h*, the heart; *v*, right ventricle; *v'*, left ventricle; *c*, right auricle; *c'*, left auricle; *a*, aorta; *d*, vena cava; *e*, greater circulation; *b*, smaller circulation; *f*, pulmonary artery; *g*, pulmonary veins.

Away goes the blood into the arteries (*a*), into the capillaries (*e*), where it supplies nutriment and receives the refuse, and on through the veins (*d*) into the right side of the heart (*c*). That is the *greater circulation*. The right side of the heart (*v*) then contracts and sends the blood through the arteries (*f*)

to the lungs (*b*), where it throws out the refuse, chiefly carbonic acid gas, receives oxygen, and returns by the veins (*g*) to the left side of the heart (*c'*), to be again sent throughout the system. The circulation from the heart to the lungs and back to the heart is called the *lesser circulation.*

Perhaps you noticed that I said the blood carrying the refuse passed from the heart to the lungs in arteries, and the good blood back in veins just the reverse of what takes place in the greater circulation. That is a peculiarity of the lesser circulation, but it is in accordance with the anatomical law that all blood vessels going *from* the heart are called arteries, and all those going *to* the heart are called veins.

We shall now look at the various organs concerned in the circulation a little more minutely. They are the heart, the arteries, the veins, and capillaries. And first the heart—

The heart (Fig. 11) is a hollow muscle about the size of a closed fist, and is situated somewhat to the left side of the chest between the lungs, but not so much to the left side as is commonly supposed. Assassins often go wrong for want of anatomical knowledge, and stab the left lung. Still it is not

so far to the right side as was supposed by the quack who was consulted by a patient for heart disease. The learned quack proceeded to examine in the neighbourhood of the liver on the right side, "But," said the surprised patient, "I always understood my heart was over here." "Ah, yes," replied the unabashed charlatan, "it used to be so, but we have changed all that now." A wonderful exemplification of modern progress!

As I have already stated our heart really consists of two hearts joined together, and in some of the lower mammals this division is very marked. These two hearts, left and right, are each composed of two chambers, the upper being called the auricle, and the lower the ventricle, each auricle opening into its corresponding ventricle only. The one side of the heart has no direct communication with the other. To all intents and purposes they are two hearts.

The two upper chambers, right and left auricles, contract and dilate simultaneously, and so do the ventricles, but alternately with the auricles. When the auricles are contracting the ventricles are dilating, and *vice versa*. The auricle contracts and squeezes its blood into the ventricle, then the ventricle

contracts and squeezes the blood, where? Back into the auricle? Not at all. At the communication between the auricle and the ventricle is a valve (Fig. 11) on the right side consisting of three doors, on the left of only two. These are so constructed that they will only open *into* the ventricle, so that when the blood attempts to return to the auricle, the doors are shut. Still the ventricle goes on contracting, and the blood passes out at the only opening left, viz., that into the artery.

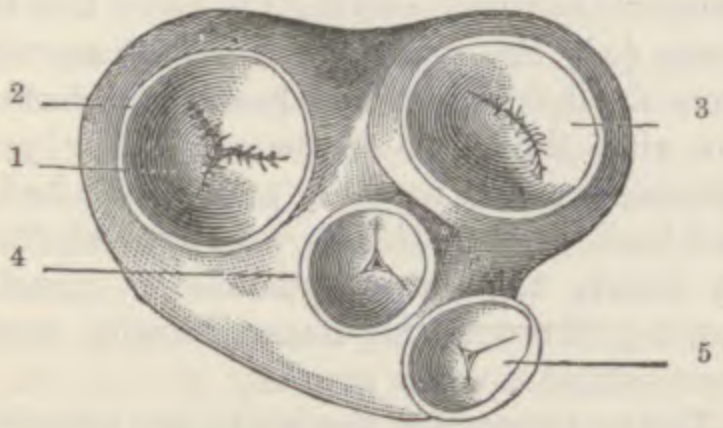

FIG. 11—VALVES OF THE HEART AND ARTERIES.

1, Right auriculo ventricular orifice; 2, fibrous ring surrounding this orifice; 3, left auriculo ventricular orifice; 4, orifice leading into the aorta from left ventricle; 5, orifice leading into the pulmonary artery from right ventricle. All these openings are closed with valves.

Take the canals here returning the dark vitiated blood to the right side of the heart.

(Fig. 10) The blood enters the right auricle *(c)*, and the valves of the veins are closed, so that it cannot go back. The auricle contracts and drives the blood into the right ventricle *(v)*, whereupon the valves there are closed; the right ventricle contracts and drives the blood into the pulmonary arteries *(f)*, valves are shut; the blood circulates through the lungs *(b)*, and along to the left auricle *(c)*, valves are shut; the auricle contracts, the blood passes into the left ventricle *(v)*, valves are shut; and the ventricle contracts driving the blood into the aorta *(a)*, the great blood vessel starting from the left side of the heart, and from it the vital fluid, the boats containing provisions, are sent to every part of the body, and back by the veins to where we started. In short, the blood pursues a circular journey through the house, closing every door behind it on its course.

The movements of the heart are attended by two sounds, which you can easily hear by placing your ear over the heart of a friend—of the same sex, of course. When the ventricles contract an impulse is caused against the ribs—the beating of the heart not noticeable under ordinary circumstances, but during emotion very perceptible indeed.

You will observe that the left heart has double the work to do, twice the distance to send the blood, compared with that accomplished by the right heart, and accordingly we find the left is double the size of the right. The heart, as a whole, is larger in males than in females; but I do not mention this fact to detract in the slightest degree from the qualities of the fair sex. The heart is, indeed, easily acted on by the emotions of the mind, but it is in no way the cause of them. In all languages sayings and proverbs abound which make the heart the source of our passions, and the eloquent perorations we hear from the pulpit draw largely on the heart. The expressions, "a heartless man," "a brave or noble heart," "a broken heart," "all great thoughts come from the heart," "wearing his heart on his sleeve," and so on, are merely the language of allegory. The heart has no part in the production of emotion, which is the function of the brain. Therefore, although the ladies have smaller hearts than the gentlemen, they are not necessarily less affectionate in their dispositions; and although, strictly speaking, they are more heartless than men, I do not think we need prize them any the less on that acoount.

The heart contracts 60 or 70 times in the minute, as may be counted by the pulse at the wrist, or by those who have knocking noises in the head. The number of beats varies with the age of the individual. A newly born infant having 130 to 140 beats per minute; 2 years, 100 to 115; 7 to 14 years, 80 to 90; 14 to 21 years, 75 to 85; 21 to 60 years, 70 to 75; but there are many exceptions to these. Young persons sometimes have a pulse under 60; one young lad I know whose pulse never rises above 40, and there are others who habitually have their pulse running about 100. Ladies have quicker pulses than the sterner sex, their smaller hearts having to beat faster to get through their work.

Disease of course modifies the rate at which the heart goes—acute diseases running it up to 150 or even 200, and others such as apoplexy putting it as low as 20 or 30.

Let us now leave the heart and accompany the blood on its voyage through the body. Here we have the largest blood vessel of the body, the aorta (Fig. 12, *a* and *n*), which arises from the left ventricle of the heart, and is like the main pipe starting from the Reservoir at the top of the Garlie Bank. It has not gone far before it gives off a branch pipe for

each arm (Bellbrae and Sandilands), and a branch pipe for each side of the head. It then passes down the chest, supplying

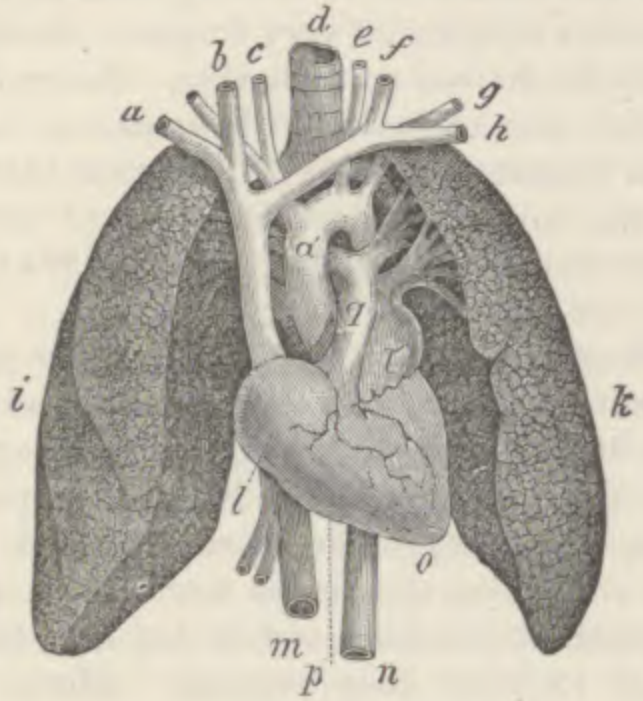

FIG. 12.

The lungs, heart, and principal blood vessels in man—*a h*, veins from right and left arms; *b f*, right and left jugular veins returning the blood from the head and neck—these four veins unite to form a single trunk, the *vena cava superior*, which enters the right auricle, *l*; *c e*, the right and left carotid arteries; *a'*, the arch of the aorta; *g*, the left subdavian artery; *d*, the trachea or windpipe; *i k*, the right and left lungs; *e l'*, the right and left auricles; *p*, the right ventricle; *o*, the apex of left ventricle, where beating of heart is felt; *m*, the inferior or ascending *vena cava*; *n*, the descending aorta; *q*, the pulmonary artery.

branches everywhere to all sides of the chest and abdomen (say both sides of Wemyss

Place and the Crossgate), then branches into two trunks for the lower limbs (Bonnygate and St Catherine Street), each of these branches sending off very frequent shoots to serve the houses on each side. Every little branch communicates with numerous other little branches, so that if one gets blocked up the supply of blood is conveyed by the others to the required destination. We have no dead ends here!

The arteries, then, are simply water pipes containing blood, with this important advantage over Mr M'Leish's pipes, that they repair themselves from the blood as it passes along. As they suffer from wear and tear like everything else in the world, they must be repaired somehow, and so they help themselves to what they require. Moreover, they are not hard, stubborn pipes. On the contrary, they are elastic and contractile, and these properties are most valuable in moderating the violent jerk given to the blood in the first instance by the heart. So great is this moderating influence that the blood, instead of flowing along in a series of jerks, finally moves in a continuous stream. Again, when an artery is cut across, say in an operation, taking off a leg for instance, its contractibility comes

into play, and it is very easily stopped bleeding. Supposing this to be the stump of a leg, and this the cut end of an artery. One surgeon catches hold of the vessel with the forceps, and another ties a ligature round it. We now use catgut for this purpose. Formerly silk was used, one end being left out of the wound to be withdrawn in 10 or 14 days. The catgut, however, is cut short, and no more is heard or seen of it. The artery heals up, and the catgut gets absorbed. Well, have we a dead end here? By no means: the branch nearer the heart enlarges and carries on with its neighbours the circulation which was formerly performed by the tied vessel which shrivels up.

The arteries are the canals conveying the boats with the provisions to the various tissues. The blood flows in them in a series of pulsations as can be noticed at the wrist by placing a finger on the radial.

We shall now follow the boats into harbour, viz., into the capillaries, which are the little tubes connecting the arteries and veins. These are so small that some of them will only admit of the entrance of one blood corpuscle or boat at a time, whilst others can accommodate two or three. Strictly speaking, they are not harbours at

all, for the blood does not stop, it merely slackens its speed like an express train shutting off steam when passing Ladybank.

FIG. 13.

Capillaries—*a*, the artery; *b*, the vein; *c*, the intervening capillaries.

Here we have a diagram of capillaries (Fig. 13, *c.*) spread out like a net. The artery (*a*) is seen here giving off a branch pipe, which spreads out into the capillary, and then collects itself together again to form a vein (*b*).

These capillaries exist throughout the body. When you prick your finger with a needle, when you scratch the skin against a hedge, you break into this network and a little blood oozes out. In them it is that the boats discharge their cargo of food and take in the refuse. In them little hands are constantly seizing the needed supplies of food as the blood passes by.

It is a temporary accumulation of extra blood in the capillaries of the skin of the cheeks which is the cause of blushing, and it is a distended condition of these same vessels which produces that fine fast colour of the nose which is seen in those who live not wisely but too well. The nose may be said to be blushing for what has gone down the throat!

The quantity of blood in the capillaries varies at different times, and depends very much on the activity of the particular part. Thus, during digestion, when the stomach and other chylopoietic viscera are busily en-

gaged pouring out secretions, the quantity of blood determined to them is very greatly augmented. Again, when the brain is in active operation there is a great flow of blood to that organ, so that it is great folly to do brain work whilst digesting food.

Mother's marks, those little red appearances often resembling strawberries, are simple collections of these little capillaries in particular parts of the skin.

Now, whereas the blood enters the capillaries from the arteries of a bright red colour, it leaves them of a dark purple hue. When your nose bleeds you will notice that the blood is sometimes bright, and at other times dark like porter. If it is bright red it is arterial blood, and if dark it is venous; and you should always pay attention to the colour of the blood discharged, as it may give useful information to your medical attendant, and you must notice the colour at once. Although blood flowing from a vein is dark when it leaves the body, it changes to a bright hue as soon as it is exposed to the air. The chief apparent difference, then, between arterial and venous blood is the colour, and that difference of colour is entirely due to a change in the shape of the red corpuscles. In the arteries

these are flat or biconcave and red, and contain much oxygen and little carbonic acid. After they have served their purpose and are returning in the veins, they are round and dark, and contain much carbonic acid and little oxygen. They have a remarkable power of absorbing oxygen, and giving out carbonic acid.

It has also lost much of its express speed. When it left the heart it was going at the rate of 1 foot per second ; in passing through the capillaries the speed was reduced to 1 inch per second, and now in the veins it goes at the rate of 4 inches per second. How is this ? You may have noticed that the Eden moves very quickly at Spital Mill, but when it gets down to Edenfield and is further spread out it goes very slowly ; and again at Tarvit Mill is getting along much more rapidly. The same takes place with the blood. It is confined in narrow space in the arteries and moves quickly ; in the capillaries it is greatly spread out, but when it gets into the veins, which contain 2 to 3 times as much blood as the arteries, although less than the capillaries, it gets on faster, but not so fast as in the arteries.

The great peculiarity of the veins is the circumstance of their having valves at very

frequent intervals to prevent the blood flowing back the wrong way.

This is a wise arrangement, because the veins are very liable to get pressed upon. When the muscles are in action they compress these vessels and stop the flow of blood in the particular part. The valves close and the blood cannot return (you must remember that venous blood is hurtful and is going to be purified), but there being no dead ends, plenty of communication from one canal to another, the blood is sent round another way till the pressure is relieved. You may see this very well in a horse after he has been running hard. The superficial veins are all standing out like cords, and when he rests these speedily become imperceptible again. Nothing of this kind occurs in the arteries after they leave the heart—they are not so liable to pressure and require no valves.

If the arteries resemble our water supply, the veins would represent our system of drainage if we had one.

Into the veins open lymphatics, little absorbent vessels, which run alongside and which form the small swellings often seen in the necks and under the arms of children, and into the large vein of the left side of

the chest opens the thoracic duct with the digested chyle.

Finally, the whole venous system forms two trunks, one from the head and another from the trunk, both opening into the right auricle.

There are two parts of the venous circulation to which I must draw special attention.

1. The blood from the stomach, spleen, sweetbread, and intestinal canal is sent through the liver, and is purified by the formation of bile before being returned to the heart.

2. The veins going to the heart from the lungs contain bright red blood—the venous dark blood being conveyed by the arteries.

The arteries and veins lie side by side, and are often enclosed in the same envelope. As the blood flows more slowly, but in greater quantity, through the veins than through the arteries, the vein is larger than its corresponding artery, and, indeed, there are often two or three veins to one artery.

The blood makes the entire circuit of the body in 23 seconds. Hence the modern plan of injecting medicines into the skin and so reaching the circulation at once, is much more speedy than the plan of taking medicine by the mouth.

Closely connected with the circulation of

the blood are those conditions of the body known as sleeping and dreaming. In sleep the circulation of the blood through the brain is greatly diminished both in quantity and in speed, and, as a consequence, the brain ceases to act so far as its consciousness of external objects is concerned. Some parts of the brain *never* sleep. Those portions of it which preside over breathing, and the circulation of the blood, and the movements of the intestines, *never* sleep, and fortunately so. Suppose that the action of the heart were dependent on a part of the brain which was liable to go to sleep. None of us would very long continue to live.

The direct cause of sleep is that feeling of exhaustion or fatigue which generally supervenes after we have kept awake and active during the greater part of the 24 hours; the brain requires rest—a repose which can only be obtained from Nature's sweet restorer.

Amongst the indirect causes which predispose to sleep are darkness and silence, though, strange to say, persons accustomed to continuous noises, such as mill-wheels, cannot sleep if the noise stops. Monotonous sounds are very apt to produce sleep. A dull sermon is a familiar example of this, many people being quite unable to resist the

tendency to sleep in church. We must admit, however, that some do not try very hard! You have all heard, I dare say, of the old woman whose sleeplessness during a tedious illness had proved intractable to all kinds of sleeping draughts, but who was at length without difficulty lulled over to profound slumber by the desperate expedient of getting her minister to come and preach to her. There is one point to be borne in mind by habitual sleepers in church, which was well put by the beadle in a church of old Aberdeen when he had occasion to waken one of the congregation who was sleeping too noisily, "We dinna object to ye sleepin', my mannie, but ye mauna snore and wauken yer neebors." Young infants and very old people sleep a great deal, and for the same reason—that during sleep less wear and tear goes on, and more time is gained for the repairing of the tissues. Dull, heavy, phlegmatic people require a great deal of sleep, and, indeed, never at any time appear to be more than half awake. Bright, cheerful people, on the other hand, do not seem to require so much, at least so long a sleep, for it is not quite just to measure the amount of sleep by the time occupied. So much depends on the *soundness* of the slumber.

Eight hours is a very good allowance for any of us.

Dreaming is produced when part of the brain is asleep and part awake—unconscious cerebration. When we take a heavy supper and go to bed the poor stomach has to go on working, an extra part of the brain, which should be asleep, has to keep awake to superintend the digestion, and from sympathy some other part of the brain begins thinking, and generally in a very unpleasant way—probably nightmare is the result. As a rule, dreams are referrible to some unusual condition of the body. For instance, Dr Gregory relates that one night when his foot touched a hot water bottle or pig during sleep he dreamed he was walking up Mount Etna, and found the ground intolerably hot. Dr Reid, having a blister applied to his neck, dreamed that he was scalped by a party of Indians.

All dreams relating to coming events, finding treasures, deaths in the family, and so forth, are merely coincidences in those cases where they come true, and it is nonsensical superstition to pay the attention to these that many people still do.

I think sufficient has been said to show the importance of the blood to the due working

of all our functions, and it is unnecessary to dilate on the evil consequences of losing much blood. Bleeding or hæmorrhage differs in its character according to the nature of the vessel from which it escapes. When a vein is wounded the blood is of a dark colour, and flows in a uniform stream. When an artery is wounded the blood is of a bright vermilion or scarlet colour, and flows in jets. But we may have bleeding without a wounded blood vessel at all. Take spitting of blood from the lungs, for instance. In most cases the blood simply oozes through the canals, and there is no rupture. The same thing occurs in bleeding from the nose—the fluid transudes through the vessels. I must remark here that it is not always judicious to stop bleeding at the nose all at once. In a full blooded person, eating too much and working too liitle, more blood is formed than is required, and accordingly the system relieves itself. But when the bleeding goes on too long or recurs frequently it is necessary to arrest it. Cold to the spine and head help. Holding the arms well up lessens the supply of blood to the head, and so is often sufficient to diminish the bleeding. We have remedies which act well in these and all other bleedings by making the blood-

vessels contract, and any of us will be very glad to prescribe these for any of you when we are called in. There is no use in telling you too much!

Besides this oozing through the coats of the vessels we may have complete rupture, and if the broken blood-vessel is of any size this is a very serious matter. If small, a clot is formed in the rupture, the vessel contracts, and if the patient keeps quiet all will be well; but a vessel of any size breaking is generally fatal in a very few minutes. What can you do? Not much. Always keep your head; do not get into a fizz. Keep the patient in the recumbent position, with the head low. Admit plenty of fresh air, the colder the better; therefore, throw open every window and door in the room, and have as little covering on him as possible, and remember not to give anything hot for some time. Ice, if it can be had, and cold drinks are best. I shall have occasion in the last lecture of the course to point out the best mode of treating cuts and wounds till the doctor comes, but I shall now tell you of what has been done with success in cases where the hæmorrhage has been stopped and yet the previous loss of blood has been so great that the patient is in imminent danger

of dying from its effects. I refer to the operation of transfusing blood, that is, the taking of blood from one person and passing it into the veins of another. It is an operation of great delicacy, and requires care lest air be at the same time injected, which would be probably fatal. Here is a syringe which would do for the purpose. Draw fresh human blood from one of the veins, fill the syringe, see that all the air is excluded, make an opening in a vein at the elbow, insert the canula, and inject the blood. It must be done steadily and quickly before the blood has time to coagulate. A good many lives have now been saved by this means, and all credit is due to those heroic souls who have cheerfully bared their arms and sacrificed some of their own blood to preserve the life of a fellow-creature !

When we think of the importance of the blood in the economy of the body, it is difficult to believe that not so long ago bloodletting was the panacea for all the ills that flesh is heir to. Nay, it was considered the correct thing for persons in perfect health to be bled every spring much as we go to the seaside every summer. Happily these days of bloodshed are over.

Next to losing blood altogether is the im-

portance of having that vital fluid circulating in a healthy way. Besides a feebleness of circulation, causing cold hands and feet (which suffer most, they are furthest from the heart), we may have the blood itself in a diseased condition.

Blood poisoning, you are doubtless aware, is a very dreadful occurrence. As commonly understood, the term is held to mean cases in which putrefying material has been absorbed into the blood, from a suppurating wound for example, when abscesses are formed in some or other of the internal organs, and unless the poison be speedily got rid off, death is the result.

But beyond this, we may have the blood poisoned with specific diseases, such as measles, small-pox, scarlet fever, diphtheria, hydrophobia, typhus and typhoid fevers, which are all examples of blood diseases. It is a well known fact that all these diseases so alter the blood that it is not again liable to be affected by the same disease, and the researches of Pasteur, a French chemist, on the germs of disease are rapidly bringing to pass the time when these affections shall be unknown. You all know, and I hope you all believe in, the merits of vaccination to protect us against small-pox. Well, Pasteur

has come to the conclusion that cow-pox is simply a cultivated variety of small-pox—a milder form. He applied this theory to the disease known as anthrax or splenic fever amongst sheep which extensively prevails on the Continent, and is propagable to man, and which caused between 1867 and 1870 above 56,000 deaths among horses, sheep, and cattle, and 528 human deaths in the single district of Novgorod in Russia. We had a mild outbreak of this disease between 1850 and 1860 in this country, and lately attention has been drawn to a severe, and often fatal, malady occurring among the wool-sorters of Bradford, communicated by the wool of the sheep.

Well, Pasteur resolved to try vaccination. He found the germs to be small vegetable growths circulating in the blood, introduced into it by the lungs. We all know that some of our most cherished fruits are cultivated varieties of plants, which, in their wild state, are poisonous. In like manner Pasteur obtained these plants, called Bacilli, from the blood and intestinal canal of affected sheep, cultivated them in meat juice or chicken broth, and with this cultivated germ inoculated healthy sheep. If I relate one such experiment I think it will be enough

to prove the value of his discovery. He vaccinated 25 sheep with the mild virus on 3d May last, and on 31st inoculated the same 25, and other 25 with the strongest virus, and he predicted that on the following day the 25 unprotected sheep would all be dead, whilst the others would be quite well. A large crowd assembled on the following day, 1st June, and it was exactly as he had said. At two o'clock 23 of the unprotected were dead, the 24th died within an hour, and the 25th one hour after. The protected sheep were all quite well, and so far as I know are alive yet.

The practical point is this: If we can discover the particular germ causing a particular disease all we have to do is to cultivate that germ and protect ourselves by vaccination. This line of research is being followed by many workers in the scientific world, and I believe the time is not far distant when we shall not only be vaccinated for small-pox, but in a dozen different places to protect us against fevers, measles, diphtheria, cholera, and whooping-cough, which will then become things of the past. And if these, may we not hope that that fell disease consumption and all the varieties of that fearful scourge, scrofula, may in turn

be cultivated and stamped out; that the physician, instead of curing, will prevent; instead of prescribing a nauseous dose, will protect his patients by vaccination, and that that happy time will arrive when disease shall be unknown, and old age the natural end of life.

Besides going wrong itself, the various organs concerned in the circulation may be the subject of disease. The heart may have its muscular tissue replaced by fat, and so become unable to do its work effectively. Some day it is asked to do more than usual—to climb a hill, to lift a heavy weight. It makes the effort—fails, and sudden death results! Some of its valves may go wrong. They may get hard and brittle, or little excrescences may grow on their margins so that they cannot close properly, and so allow the blood to flow back or regurgitate; or it may be that they do not open sufficiently to allow a proper quantity of blood to enter. Either state of matters is serious, the circulation getting obstructed, and relieving itself by pouring out its water at various points, and so causing dropsy.

The heart is quite insensible, as Harvey showed Charles I., when he made him touch the heart of Lord Montgomery's son, which

had been exposed by a wound of the chest. The pain sometimes complained of as being in the heart is generally caused by neuralgia of the muscles of the breast.

Palpitation of the heart is simply irregular action of that organ. Instead of beating calmly as usual it gives a quick succession of flurried beats. This may be due to heart disease, but most commonly is caused by flatulence in the stomach pressing on the heart, and giving it too little room to work in.

Palpitation in the young of sweet seventeen and upwards is generally not of organic origin.

Then the arteries may and do become brittle with age. Their elasticity leaves them and the violence of the rush of blood upon their walls causes them to dilate, the result being aneurism. In this serious disease every beat of the heart tends to weaken the thin wall till at length it gives way altogether. Without forming aneurism, the wall of the artery having become brittle may burst. When this happens in the brain we have apoplexy and paralysis. Nature is a grand surgeon, and in many cases causes this clot to be absorbed when the function of the part is restored.

The veins may become enlarged—varicose veins are familiar to you all. Much standing on one's limbs, carrying heavy weights, tight garters, all prevent the return of the venous blood, which has to go uphill as it were. We all know what a comfort it is when fatigued with much walking, to put our legs up on a chair in front of us. That is simply favouring the circulation.

These, then, are some of the principal points connected with the circulation of the blood.

Do we wish to keep our blood pure and to have all our tissues in good working order? Then let us lead healthy lives, let us take regular exercise; regular well-selected, well-cooked meals, lead cleanly lives both morally and physically, and we shall attain, if God wills it, a happy old age; with a sound heart, our arteries elastic, and our veins free from varices; safe from aneurism, with no haunting fear of apoplexy and not a trace of dropsy, we shall be enviable witnesses of a well spent life.

No. IV.

RESPIRATION AND THE AIR WE BREATHE.

In last lecture we accompanied the blood in its circulation throughout the body. We saw that it leaves the left side of the heart good, bright, arterial blood, containing much oxygen and little carbonic acid; and that when it arrives at the right side of the heart it is dark, venous, used-up blood, containing much carbonic acid and little oxygen. The oxygen has been utilized in oxidising the waste material of the system, and so forming various compounds injurious to the blood, and therefore necessary to be got rid of before it can again become pure and fit for its work. The liver abstracted some of these impurities, and worked them up into bile; the kidneys removed others of them; the skin did its share; but after all we have the blood returning to the right side of the heart in a very impure state. It is loaded with

carbonic acid and various organic matters, which will be more or less abundant according to the activity of the other purifying organs. It is to get rid of this carbonic acid, and to get a fresh supply of oxygen, that the blood must be exposed to the atmosphere by means of the lungs.

Respiration is, indeed, one of the most important processes of animal life. When we consider that the first act of our lives is to inspire, and the last to expire ; when we reflect on the many and serious diseases which are connected with the organs of breathing—such as asthma, croup, bronchitis, and that terrible scourge of our native country, consumption (which in England alone carries off every year 60,000 lives)—it is clear that our knowledge of this subject cannot be too extensive, and that due attention to some of the considerations which we shall discuss to-night may be extremely beneficial in the advancement of that noblest ambition of modern medical science, the prevention of disease.

After circulating through the body, the blood is sent by the heart to the lungs, much as we send soiled clothes to Mr Pullar at Perth, to be revived, and to have its colour changed from dark blue to bright red. This

change is effected in the lungs by means of the air we breathe. Oxygen is taken in and carbonic acid given out, and this operation goes on from birth to death. Whether awake or asleep, conscious or unconscious, we *must respire.*

Now, how is all this effected? We draw in fresh air through the nose or mouth, or through both, according to the taste of the individual, and send it down the larynx. The larynx is the special organ for the production of sound, containing as it does the vocal cords. It also serves for respiration, and is composed of four cartilaginous structures which keep it always open. These are the cricoid, the two arytenoid, and the thyroid. This last presents in front the prominence known as Adam's apple, so-called from the—perhaps natural but quite erroneous—idea that our first parent did *not* swallow his portion of fruit, whilst mother Eve got hers over without difficulty. This prominence, however, exists in the fair sex also, but is less apparent from the circumstance that the thyroid gland is greatly developed in the female, and conceals the prominence. It is enlargement of this gland which constitutes goitre or Derbyshire neck. On the upper orifice of the larynx is a valve,

the epiglottis, which prevents food from passing into the air passage, a most important provision, for we all know how painful it is to swallow even a crumb the wrong way.

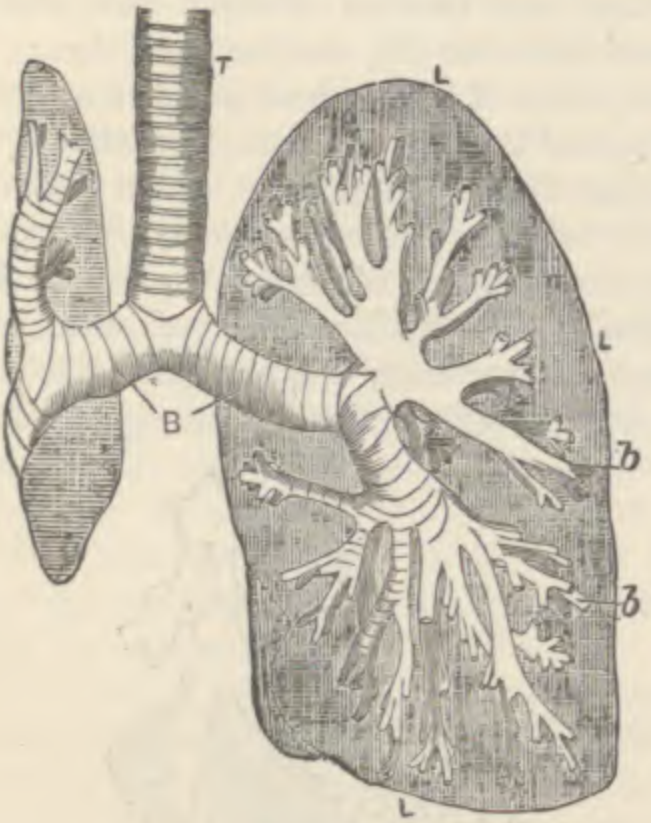

FIG. 14.

Ramifications of the air-tubes in the human lungs.
L, the outline of the left lnng; *T*, the trachea or windpipe; *B*, the right and left bronchi; *b b*, bronchial tubes which subdivide into an immense nnmber of minnte tubes, which again end in clusters of cells, the lung-saes or lobules.

Next comes the trachea or windpipe, (Fig. 14 T) composed of a series of cartilagi-

nous rings. This is the seat of that terrible disease, croup, in serious cases of which it is sometimes necessary to open the windpipe in order to allow the patient to breathe freely.

Then the trachea divides into the two bronchial tubes (B), one for each lung. Inflammation of the mucous membrane of these tubes and their ramifications constitutes the familiar disease, bronchitis. In it the calibre of the tubes is diminished from the swelling and accumulation of mucus, hence we have difficulty of breathing, and we instinctively cough to clear away the phlegm, after which there is relief for a time till it again collects.

FIG. 15.

Lung-saes or lobules.

b, bronchial tube; *c*, outer surface of lung-sae; *d*, inner surface of lung-sae cut open to show the air-cells.

This explains the great ease experienced by children suffering from this disease when they vomit freely.

Each of these bronchial tubes is divided and subdivided almost to infinity. (Fig. 15.) It is calculated that there are about 500 millions of these divisions in each lung. Around these are spread the ramifications of the blood vessels coming from the heart, and the entire mass of these air vessels and blood vessels, with the cellular tissue containing them, constitutes the lungs. By means of this wonderful arrangement about 15 square feet of blood are exposed to the air at one time. So we see how easily the oxygen is taken from the air into the blood, and the carbonic acid thrown out. It is in this way, also, that the vapour of chloroform is introduced into the system.

Each lung is enveloped in a membranous covering folded on itself like an old-fashioned nightcap, and called the pleura. When this is inflamed we have pleurisy, the sharp pain of which is caused by the two folds rubbing against each other.

Then we may have the substance of the lungs themselves in a state of inflammation (inflammation of the lungs, or pnuemonia), the first stage of which is congestion of the

lungs (too much blood determined to them), and when both the enveloping membrane and the lung itself are inflamed the disease is called pleuro-pneumonia.

Consumption is simply a breaking-up of the upper part of a lung, an abscess or gathering forms, and the result in most cases is that the drain on the system is too great to be borne, and the fatal termination which too many of us have had the misfortune to witness in our own family circles, takes place before long.

Lastly, that very painful complaint, asthma, is caused either by a spasmodic contraction of the bronchial tubes or by a collapse of some air-cells of the lungs.

It is not within the scope of this lecture, nor is it possible to give directions for the cure of these diseases; but I may mention, as prevention is better than cure, that healthy exercise in the fresh air, singing, calisthenics, and even the playing on wind instruments are peculiarly beneficial in strengthening the chest, and so lessening our liability to these affections.

Besides all these organs, the larynx, the trachea, bronchial tubes and lungs, which are known as the respiratory tree, we have a large muscle, the diaphragm, separating

the chest from the abdomen, and playing an important part in respiration.

We are now in a position to understand the process of breathing. First of all, then, we draw in air—the act of inspiration—by raising the ribs and lowering the diaphragm. A vacuum is thus formed, and the air enters the lungs. A slight pause then ensues, and then we breathe out—the act of expiration—by lowering the ribs and raising the diaphragm, by means of which the air is squeezed out. There is then a longer pause till inspiration again takes place, and so on.

In entering and leaving the lungs the air makes a rustling noise which can be easily heard by the ear, and very audibly, by listening at the back between the shoulders. Medical men use a stethoscope for this purpose, but an instrument of this kind, "a theological implement," as I once heard it named, does not make the sound stronger, it merely conducts it. By means of this we can hear what is going on in any particular part of the chest, and, besides, it is not always safe to put one's ear directly to the chest of everybody. The healthy breathing sound is like a gentle breeze rustling the leaves of a tree, but in disease many other sounds are to be heard of great value to the physician.

When there is a hole in the lung from consumption, for instance, we can sometimes hear a drop of matter fall from the ceiling to

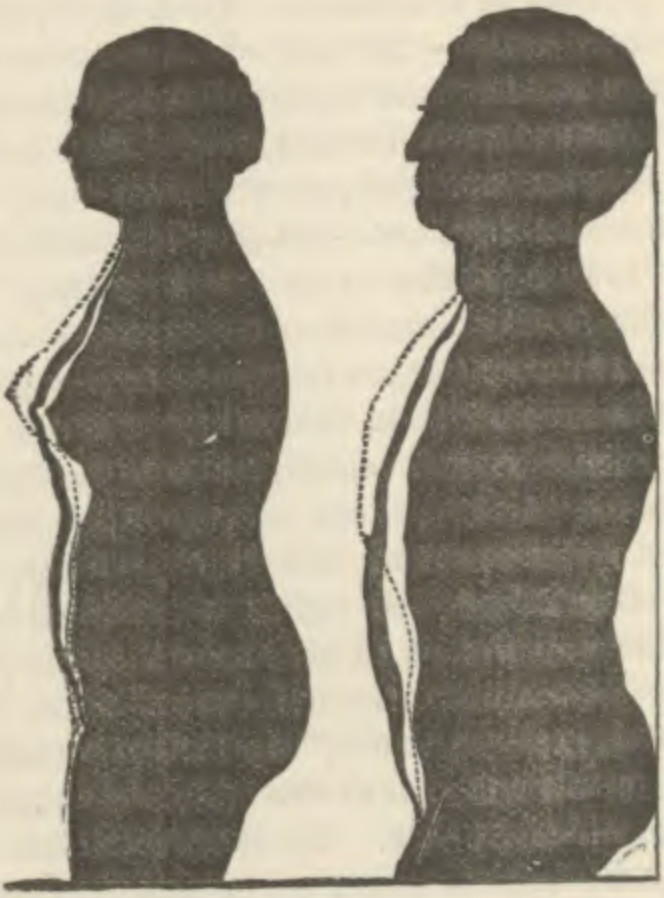

FIG. 16.

Diagrams showing the extent of movement in ordinary and in forced respiration in male and female. The back is supposed to be fixed, in order to throw the movement forward as much as possible. The black line indicates, by its two margins, the limits of *ordinary inspiration* and *expiration*. In *forced* inspiration the body comes up to the dotted line, while in *forced expiration* it recedes to the smallest space indicated.

the floor; and you are all familiar with the wheezing which is heard in asthma and bronchitis—mostly due to the contraction of the bronchial tubes, and to the air having to pass through the phlegm. After coughing and expectorating freely the wheezing ceases for a time. You should never try to listen to your own breathing. You may get as great a fright as the medical student did who applied a stethoscope, with a speaking trumpet attached to it, to his chest. Some mischievous companion had previously introduced a fly into the instrument, and the frightful buzzing he heard gave him a considerable scare.

You may notice a difference in the mode of breathing of the two sexes. The fair sex move the upper ribs only, but men and infants the lower ribs, and the diaphragm, and what is called abdominal respiration takes place (Fig. 16.) These acts are for the most part involuntary, as we see in sleep and in insensibility, but are also to some extent under the control of the will as shown by the power we have of regulating our breathing in singing, blowing out a candle, and playing the cornet. These movements take place pretty regularly, and about 18 may be counted per minute, but there are some

irregularities to which I may allude. Of such are the sighs of the love-sick maid, the hiccup of the midnight reveller, the sneezing of the unpractised snuff-taker, and the yawning of the sleepy child. Then we know how closely allied are the laugh of joy and the sobbing of grief—it is a common expression that one does not know whether to laugh or cry.

We are not to suppose that we empty and fill the lungs at every breath. As long as life continues, and even after death, they are *never* empty. Expire as forcibly as we can, there is still in the lungs air to the extent of 90 cubic inches, called residual air. In ordinary respiration we breathe in 20 cubic inches, size of an orange, which is only about $\frac{1}{14}$th of what the lungs can contain. Still that is a good deal. It means that we breathe 12 quarts of air per minute, 720 quarts per hour, 4320 gallons in a day.

The amount of air which can be expelled by the most forcible expiration after the most forcible inspiration is called the vital capacity, and is measured by the spirometer. You will find that the taller a man is the greater is his vital capacity.

You will perhaps be surprised to learn that besides respiration by the lungs, we

have another mode of introducing oxygen to, and withdrawing carbonic acid from, the blood—viz., by the skin. In some of the lower animals, indeed, this is a very important part of their respiratory apparatus—in the frog, for instance. Hence we have here an additional reason for attending to personal cleanliness. If we allow our skin to be clogged up with accumulated sweat and dust we throw on the lungs an undue share of work in purifying the blood, and keep circulating in our systems organic products which ought to have been removed at once. Most parents are sufficiently careful about washing thoroughly their *babies* at least once a day, but, strange to say, after the children grow up a little bit, the Saturday evening tub is considered to be all they require, and a very perceptible line of demarcation is very often to be seen on the neck at the point where the daily washing of the face ceases. In every case where it is at all possible the whole body should be washed every day. Those of you who do not possess a bath are sure to have a tub, and in the absence of that a plain rub down with a wet towel is better than nothing. In very cold weather the cold chill may be taken off by the addition of a little warm water, but if

the bath be taken regularly there are few mornings in which a quite cold dip is too great a shock. It is a grand preventive of cold, and in time becomes a cherished luxury as necessary to one's comfort as clean linen.

And talking of clean linen, I would draw attention to the fallacy too commonly entertained that clean underclothing is merely required for ornamental purposes, and that if we are clean on Sunday it does not matter for the rest of the week. This is a great mistake. Dirty clothes are not only unhealthy but they are wasteful, because when they go to the washtub they have to be rubbed hard, and are worn to a far greater extent than if they had been sent thither only slightly soiled.

Whilst on this subject of dress allow me to remark that in this climate none of us are safe from chills, colds, and rheumatism, unless we wear flannel. Every one, young and old, rich and poor, male and female, should wear flannel—thick in the winter, thin in the summer, and remember the good, true old saying, "Change na' a cloot till May be oot."

I do not think, however, that it is wise to wear flannel in bed either in summer or winter; and it is certainly most inexcusable folly to wear the same flannel night and day

without changing it. It should have a chance of getting fresh air to oxidise the organic particles sticking about it. This applies to all clothing. Do not throw all your things on to a chair in a huddled-up mass. Spread them out so that each may get its share of air.

We have now seen how the air is conveyed to the lungs, and we can proceed to inquire into the nature and composition of the air we breathe, and how we can best maintain that air in a state of purity.

The atmosphere is a gaseous envelope surrounding the earth, and supposed to be at least 100 miles in height, and consequently exerting a considerable pressure on the earth. A man of ordinary stature is exposed to a pressure of about 14 tons, but as the air permeates the whole body, and presses equally in all directions, no inconvenience is found to result from it. It is believed that the heads of the thigh and arm bones are kept in their sockets by the pressure of the atmosphere, and æronauts in balloon ascents often suffer from bleeding at the nose, lips, and even eyes, indicating that the strength of the blood-vessels has been adjusted with reference to atmospheric pressure.

Good pure air is composed of oxygen and

nitrogen in the proportion of 1 to 4, a very little carbonic acid, and a varying quantity, 40 to 75 per cent., of watery vapour. The ozone, which you may see mentioned in the meteorological reports, is merely oxygen in another form. The oxygen and nitrogen are not in chemical combination, simply mixed, the nitrogen serving for the most part to dilute the oxygen, for we cannot breathe pure oxygen. A vast number of substances, gases, vapours, and solid particles, are continually passing into the atmosphere, and man with his usual perverse ingenuity, in the battle of commerce, in the race for wealth, does his best to keep up a constant supply of impurities to poison the air. Chemical works sending up noxious gases, mills belching forth volumes of smoke, particles of iron, steel, stone, clay, &c., all spoil the air we breathe, and play a very important part in the production of bronchitis and consumption. The solid particles may lodge in the mouth or nose, or may pass into the lungs and remain there as sources of irritation, whilst the gases are passed straight into the blood. These are drawbacks attendant on civilisation to which we must in the meantime submit; they are every day being lessened, and when we get

the electric current in operation, for lighting and heating, and driving machinery, we may hope they will be quite overcome.

Then we have the germs of disease floating in the atmosphere, and carried from place to place—it may be for many a mile—by the currents in the air. You may remember that last week I referred to these germs as being little vegetable or animal growths, producing each its own disease—measles, fever, and all other epidemic diseases of the blood.

These are carried from one place to another by the wind, and possibly by flies and insects, and when they settle on a fruitful soil, are breathed in by a person whose body is in a proper condition for their growth, reproduce their appropriate disease. I also told you that the time is coming when by vaccination with the cultivated germ we shall be able to breathe the deadliest germs with impunity, but I now wish to impress upon you that they will only thrive, will only take root, will only do any harm, when they land in a suitable soil. Hence we see in all epidemics that the weakly ones, the feeble offspring of parents in bad health, the intemperate, the ill-fed and poorly clad, are the first to be affected and the most severely dealt with, whilst the strong and robust, the

temperate in all things, the judiciously fed and the warmly clad, are only affected when subjected to a strong influence of contagion.

In Cupar we are wonderfully free from epidemics of all kinds.* We do have occasional cases of fever, measles, and other zymotics, but these do not reach at any time alarming proportions. It is possible that our geographical position may have something to do with this. The Lomond Hills do undoubtedly break the west winds into two currents of air, one passing to the north and the other to the south of Cupar, and if our immunity is due to this circumstance, it is cheaply purchased by the loss of an occasional shower of rain, which so often tantalizes us by passing bye on either side.

If this is not so, I suppose we may take some credit to ourselves that we lead healthy lives.

The impurities I have mentioned, chemical nuisances, smoke, germs of disease, are in the open air counteracted by a wonderful series of processes carried on by nature. Gases diffuse and are carried away by winds; and are so diluted as to be rendered innocu-

* This statement, though true at the time it was made, requires reconsideration in view of the subsequent outbreak of Scarlatina, the most severe epidemic that has occurred in Cupar for many years.—W. W.

ous. Solid substances fall by their own weight or are broken up into small particles which are washed down by rain ; but in addition to this there is the grand laboratory of the vegetable world which keeps the carbonic acid of the atmosphere within certain limits. It is indeed fortunate that plants absorb carbonic acid and give out oxygen, thus helping to maintain the equilibrium. Hence plants in a room are rather good than otherwise, provided we take care to remove dead leaves.

It is only in a room, however, that the influence of plants in purifying the atmosphere is at all appreciable. The forests, the prairies, the meadows, the cornfields and gardens—the mighty expanse of plant life covering mountain and valley—do, no doubt, live on the carbonic acid exhaled from the lungs of animals. Plants take up this carbonic acid, mould the carbon into their own substance, and set free the oxygen, once more returning it to the atmosphere. Animals reverse the process, taking up the oxygen, and giving out carbonic acid for the nourishment of plants. This dependence of plant on animal, and of animal on plant, is not an idea to lose its charm by becoming familiar, but it sometimes leads to miscon-

ceptions. What, for instance, seems more natural than that the influence of trees planted in our cities should be very beneficial? And yet we have not discovered any test delicate enough to appreciate the influence of plants on the atmosphere in which we live. The depth and compass of this air ocean are too vast, the amount of oxygen absorbed by animals too trivial in comparison for any effect to be appreciable; moreover, the mixture of the gases in the air and their mutual diffusion is so rapid that no difference can be detected in the proportions of oxygen and carbonic acid in the air of crowded cities, or wooded valleys, or forest groves (Lewes). To give an idea of the insignificant part played by animals as vitiators of the air, I mention the calculation made by the distinguished chemist, Dumas, that all the oxygen consumed by animals on the surface of the globe during 100 years would not amount to 1-8000th of the quantity in the atmosphere, and supposing there were no vegetation to purify the air there would still need 10,000 years before the diminution of the oxygen could become appreciable.

The sunlight is another influence which keeps the air pure. All manner of decomposing organic substances, all germs of

disease are rendered innocuous when freely acted on by the rays of the sun. The cheering beams of the orb of heaven have a surprising effect on our health and spirits. We all know how different we feel, how much more cheerful and contented we are, how much more disposed to take a *sunny* view of life, when the sky is cloudless and the sun shines; and the vivacious manners of our lively neighbours, the French, are partly due to the genial weather and bright sunshine which permit them to be in the open air all day. We should all strive to admit as much light to our houses as possible; keep up the blinds, let the rays of the sun pour in, and increased health will amply repay for a faded carpet.

By these means, by diffusion, by winds, and by sunshine, nature keeps the open air properly mixed, so that when nature gets fair play the air is always sufficiently pure for the wants of man, and so we should do well if we were always in the open air; but that is, of course, impossible. We must have shelter, and to such an extent are we dwellers in houses that some of us scarcely ever pass over the threshold from one week's end to another. This leads to a fresh complication, to new phases of the air we breathe.

Inside our houses we are in ourselves, in our own proper persons, a fruitful and constant cause of vitiating the air, by means of the carbonic acid we expire. In the open air this is quickly diffused, and does no harm; but in our dwellings the deadly character of this gas, and its fearfully evil effects on human health, cannot be over-estimated. Suppose that respiration is totally suspended, and the carbonic acid retained in the system, a condition arises to which the name of asphyxia has been given, the essential character of which is the cessation of muscular movement, and then of the circulation of the blood. The same thing happens if an *insufficient* quantity of pure air be supplied. Sooner or later the air is used up, and asphyxia ensues. There are several well-known instances in which the speedy death of a number of persons confined together has resulted from neglect of the most ordinary precautions for supplying them with fresh air. That of the Black Hole of Calcutta has acquired an unenviable pre-eminence owing to the large number (123 out of 146) who died during one night's confinement in a room 18 feet square, provided with only two windows (and of the 23 found alive in the morning, nearly all died after-

wards of fever.) On the night of the 1st Dec. 1848, the deck passengers on board the Irish steamer Londonderry were ordered below on account of the stormy weather, and the hatches were closed. The consequence was that, out of 150 persons, 70 were dead in the morning. These are, no doubt, instances of carbonic acid poisoning on an exceptionally large scale, but many of us live in rooms differing from the Black Hole only in degree. If we go on breathing the same air over and over again, we not only contaminate the atmosphere with carbonic acid, but, in a short time, from the scarcity of oxygen in the air we breathe, imperfect oxidation of the blood takes place, and more offensive products are thrown out by the lungs, as can be easily perceived in the heavy smell of a close room.

An adult man exhales 19 cubic feet of carbonic acid in 24 hours. Now, the normal amount of carbonic acid in the atmosphere is only 2-3rds of a volume per 1000. When it amounts to 3 volumes per 1000 faintness and loss of appetite are produced; 15 to 20 volumes cause severe headache; and when the amount reaches 50 to 100 volumes per 1000 fatal results ensue. But when air more moderately vitiated by respiration is breathed

for a longer time, and more continuously, the subject becomes pale, loses flesh, the general tone of the system falls below par, and the resisting power against disease is weakened. Cows kept in close stables frequently die of consumption; and how often does it happen that an individual lives for years in a vitiated atmosphere, and when he at length dies of a fever or some other epidemic, his death is attributed solely to that, and the previous preparation of his body for the reception of the poison is quite overlooked (Carpenter), and mark, it is of little consequence how *large* the room is. If there be not a good supply of fresh air, it is only a question of time how soon these evil results will follow. When we carefully close our doors and windows, light up our gas-jets, and heap coals on the fire when two or three are packed in a small bed—it may be in that abomination of abominations, a closet bed—when one small apartment has to serve for a dwelling by day and by night, for cooking, for eating, very likely for washing as well, and, as sometimes happens, for a workshop besides, then we are neglecting one of the commonest laws of health, and must inevitably pay the penalty. When to all this is added sickness of one or more of the family,

the vitiation of the air is increased tenfold, and most deplorable results will follow. We have carbonic acid poisoning in some of its many forms! It is a curious circumstance that although carbonic acid, when respired, is of such a deleterious nature, it is rather pleasant and exhilarating when swallowed. Champagne, koumiss, ginger beer, and soda water all owe their sparkle to the presence of this gas, and when it escapes are rendered flat, tasteless, and insipid.

But this is not all we do to render the air of our rooms impure. The fires in our houses consume a large quantity of oxygen; but as a vast quantity of bad air is carried up the chimney, they are rather an advantage, provided there is sufficient ventilation. The only evil effect is the large quantity of carbon thrown into the atmosphere, and this is so considerable in large towns that persons subject to asthma and bronchitis often feel at once their entrance into London air. It is very different with our gas-jets and lamps. These use up the air without doing anything to purify it in return. When I tell you that one gas-light consumes as much oxygen as three persons, and one candle as one person, you have some idea of the injurious effects produced by the combustion

of gas. These are further seen in the case of workmen employed in dark shops where the gas is almost constantly kept alight. Their pale faces, bad digestion, and shortened lives tell their own tale. It is, therefore, very injurious to keep your gas lighted all night.

The last cause of air pollution in our dwelling-houses, to which I shall allude, is the impurity caused by the escape of sewage gas from sewers and cesspools. In many houses this is constant—the drains are insufficiently trapped, or artificial warming of the house draws the sewage air upwards. Again, a rush of water down the main drain is sometimes sufficient to empty the taps of water, and these become powerless to protect us. The connection between diphtheria, bilious attacks, diarrhœa, and dysentery, and the breathing of this impure air, is too intimate to be accidental, and too commonly observed to be denied. It is now generally believed that typhoid fever cannot be produced by sewage gas unless its own specific poison be present (which, however, it often is); but there can be no doubt that the respiration of air polluted by this means renders the person exposed to it more liable to contract the disease, and less likely to recover from that or any other.

The air in our houses, then, may be polluted by our own emanations, by the combustion of lights and by the escape of sewer gas; but suppose none of these causes to be in operation, suppose the air in our rooms to be as pure as the outside atmosphere, we may be poisoned just the same from a purely mechanical cause. We may be surrounded by an ocean of pure air, but if we do not inhale it in sufficient quantity, if we do not get rid of the carbonic acid as quickly as necessary, the same results ensue as if we were dwelling in the Black Hole. I allude, of course, to the foolish habit of wearing the clothes so tight, that the lungs cannot be properly expanded. I have no wish to offend my lady friends, but it must be admitted that the fair sex are the chief sinners in this respect. By tight-lacing the chest is compressed, so that free breathing is an impossibility, and the lungs can only expand by pressing other organs out of their places. Here we have a figure of Venus, and a fashion plate taken from one of last year's fashion magazines. I cannot help thinking, however, that if Venus had clothes on, we should think her rather a dowdy, and on the whole, I believe, a slight support to the figure

by means of stays is rather an improvement to the lines of beauty which we all admire. The slighest possible support, however, is all that is compatible with health, for it has been found that the same man, who when naked was capable of inspiring 190 cubic inches at a breath, could only inspire 130 when dressed. I make these remarks without prejudice, as the lawyers say, because I think there is very little tight-lacing in Cupar, but if any of you have an inclination in that direction, I pray you to abandon it at once.

It cannot be too strongly impressed on the public that the continued respiration of an atmosphere charged with the emanations from the lungs and skin is amongst the most potent causes of disease, and especially of those zymotic diseases, whooping cough, measles, smallpox, scarlet fever, typhus and typhoid fevers, and such like, whose presence seems to depend upon a ferment or germ in the blood. (Carpenter.) Many people will tell you when you complain that the room they are living in is close, that "they don't feel it, that they are accustomed to it." But this is only partially true. When we enter a close room we sigh, we breathe laboriously for perhaps

10 minutes, and then we feel pretty comfortable, but if we go out to the fresh air and come back to the room again, we feel oppressed till we are once more accustomed to it. The explanation of this is that the supply of oxygen being insufficient our system lowers all its functions, depresses all its processes so as to require as little oxygen as possible. If this depression be frequently repeated or long sustained we pay a terrible price for becoming hardened to bad air. The first epidemic that travels around finds in us a ready victim, and we may pay for our folly with our lives.

We have now seen what are the principal causes of impure air in our houses, and what the effects, and it only remains to mention what can be done to counteract these dangers of our everyday life. Assuming that the drains are all right (and these should be periodically examined by a competent workman, especially when any smell is perceived), it is requisite to remove from our dwelling-houses the exhalations of ourselves and domestic pets, and the products of the combustion of lights; and this object can only be attained in two ways, which must go hand in hand, viz., strict cleanliness and free ventilation.

Cleanliness of the person has already been referred to as an essential element of health, and cleanliness of the house is not less important. Dust and disease are members of the same family, and loving attached relations they are, for where we find dirt we may be sure disease is not far distant. Periodical cleanings in the spring and autumn are a necessity in all houses, and the more thorough they are the better. The careful housewife leaves no cobwebs behind shutters, no places left uncleaned under the chest of drawers, or on the top of the bedstead. It may be sufficient to beat carpets once or twice a year; but it is absolutely necessary that dusting all articles of furniture, sweeping all floors, not forgetting to sweep under the bed and under hearthrugs, should be a daily work. No slops should be left littering about; no dirty clothes thrown out of sight under a bed, or beneath the cushion of the sofa. If you have a garden or a backyard, put all your movable belongings out once a week to get a breath of air, and while they are outside scrub your floors. Let this be done on Saturday if you like, but let it be done immediately after breakfast, so that when the guidman comes home to his dinner all things may be dry, bright, and shining, and rather

than spoil the effect he himself will be induced to wash and be clean. I know—none better—the difficulties working men's wives have to contend with. Large families and small wages weigh them down, and there may seem little pleasure in slaving and toiling from day to day. But keep a good heart, keep a clean house, and there will be one temptation the less, and one excuse the less, for the head of the house to neglect his home, and spend his hard-won money in the public-house.

Besides cleanliness we must have free ventilation. Now we cannot expect that the air of an inhabited room shall be absolutely as pure as the outside air, for nothing short of breathing in the open air can ensure perfect purity at every respiration. In every dwelling-room there will be some impurity of air, but it may be fairly expected that the supply of fresh air to every room shall be great enough to remove all sensible impurity so that a person possessed of a talented nose coming in from the external air shall perceive no trace of odour, or difference between the room and the outside. And when I advocate free ventilation I do not mean strong draughts to give us our death of cold.

A cold draught of air is a frequent cause

of cold, and the frigid current of air rushing along the floor is a common cause of rheumatism in the legs. Those of a rheumatic tendency should make a point of keeping their feet on a footstool or chair. It is also for the same reason dangerous to sleep on a shake-down, which is sure to be in a draught, and, besides, the carbonic acid, being heavier than air, has a tendency to settle on the floor and so to be in greater abundance there. But besides giving us colds, these strong draughts are useless for ventilation purposes, as they rush too quickly to the fireplace and have no time to mix with the air of the room. When the air enters more equally and is better distributed the movement is gently to the fireplace, and there is another movement along the ceiling, down the walls, and along the floor. How much fresh air must we have? A man gives off in 24 hours 19 cubic feet of carbonic acid, that is to say, he poisons 16 cubic feet per hour; but, besides the carbonic acid, he gives off organic matter which poisons the air long before the carbonic acid is perceptible. If he is in a large room it takes longer to use up the fresh air than in a smaller one, and accordingly we do not require to change the air of a large room so frequently—but changed it

must be. In our rooms we should have 3000 cubic feet of fresh air per hour for each person, in a hall like this 2000 cubic feet, and in hospitals 5000. But none of you are likely to measure off the air you admit to your rooms, so you had best err on the safe side and let in as much as you can; and remember there is more need of ventilation at night than through the day, because we have to allow for our gas lights.

The principle of ventilation is twofold—the extraction of the foul air and the substitution of fresh air for it. The first of these is very efficiently managed by the fireplace which no room should be without. Dampers should *never* be closed, and indeed should not exist at all.

Again, our heated breath ascends instantly to the ceiling, and Dr Arnott's ventilating valve is designed to take advantage of this circumstance. An aperture is cut in the wall over the chimney as near the ceiling as convenient. In this is suspended a valve capable of opening into the chimney, but not into the room, so that a return of smoke is prevented. A flap of 36 ins. does for a large roomful of company. With the draught in the chimney (and there is always some draught whether the fire is on or not),

the valve opens and the foul air escapes. This is within the reach of most of us; but alone it is not enough, for we must not only remove *impurity*, but we must *renew the air*. Fortunately our workmen are not at the trouble to make our rooms and houses air-tight. Through chinks and openings the fresh air enters and the foul escapes. The winds (nature's mighty ventilators) blow through every aperture they can find, and even, though to a small extent, through stone and lime. If we would only take advantage of this purifier, it is wonderful how easy it would be to keep our rooms fresh. When the wind is blowing at the rate of only two miles an hour (which is imperceptible), and is allowed to pass freely into a room with open doors and windows, it will change the air of that room 500 times in an hour. (Parkes.) A very excellent and simple plan of ventilation is to open the lower sash of the window a little, and close the opening so made below with a board. The outside air will then strike the window, and be thrown upwards to the ceiling through the opening between the upper and lower sashes. Perforated panes are another plan, but are not so easily regulated. The panes opening inwards, which we have in many of our

churches, are most excellent, only that they are generally closed when they are most needed. Whatever plan we adopt, let us have fresh air in abundance. Whether we live in a mansion, a cottage, or "up a close," let us make a point of never leaving a room without opening the windows. And, finally, let us leave the room as much as we can, and seek in the fresh air of heaven that true health of body and mind which is so necessary for the thorough performance of the daily work of our lives.

These, then, are the principal points connected with respiration and the air we breathe. The next and last lecture of the course will be occupied with practical hints as to what to do and what not to do in cases of sudden illness when no professional help is at hand, and it will therefore be more convenient to conclude to-night with a brief synopsis of the lectures already delivered.

We have seen, I have endeavoured to make plain to the best of my ability, that we take food to repair the waste which is continually going on—that that food should be varied according to the season of the year and the amount of work we perform, and that our food must be well selected and well cooked. We have also seen that the food

serves the tissues with material for repair by means of the blood which it makes. We have followed the blood in its circulation, and seen that it goes to every part of the body, carrying the necessary supplies, that on its homeward course it is purified by going through the liver and kidneys, and that finally it is renewed and revived by its contact with the air in the lungs. To-night I have striven to impress on you the urgent necessity there is for fresh air and plenty of it. Fresh air is indeed God's best gift to man. Let us inhale it freely. Let us admit it by our open windows, or better still, let us go outside and breathe it in its native freshness. On the mountain slope, on the brink of the sad sea waves, by the side of the rippling stream, let us fill our lungs with oxygen, forget amidst the ozone the cares of business and the petty troubles of life, and we shall be repaid by vigorous health, we shall be able truly to admire the beauties of nature, to find

> Sermons in stones,
> Books in the running brooks—
> Good in everything.

No. V.

WHAT TO DO IN CASES OF SUDDEN ILLNESS.

It must constantly happen amidst the changes and chances of this world—where life is so uncertain—that all of us sooner or later are brought face to face with accident and disease; and the comfort—it may be the very life of some unfortunate sufferer—may depend on our knowledge of what to do, and what not to do, in an emergency: and it is my object to-night to point out, and that in as practical a manner as possible, some considerations which everyone should bear in mind, and which may in the future prove of inestimable value. When frail humanity is assailed by disease in some or other of its many forms, the instinct of self-preservation counsels the sending for the family doctor. In cases of ordinary illness the considerate patient sends his message before 10 A.M., so that the medical man may

know in the morning how to arrange his day's work, and not be compelled to incur loss of time and bodily fatigue in going over the same ground two or three times in the day, which is frequently the result of messages being sent for him after he has commenced his rounds. It is bad enough to have to tramp down to the South Toll at 8 o'clock at night to see a patient who has been ill for a week, but it is much worse to be summoned to a similar case in the country when the Doctor has been in the earlier part of the day within five minutes' drive of the place. On behalf of my fellow-practitioners in town, I ask you as far as possible to send your messages in the morning, and further, to let your message bear what is the matter, so that we may know whether immediate attendance is required, or whether a call in the course of the morning's round will answer your purpose. We will do our best for you, and I think it is not unreasonable to ask you to help us in this particular.

But in the case of sudden illness, and especially in cases of accident, we must be summoned immediately, and the profession prides itself on the readiness and cheerfulness with which it at once answers such a call. It must be borne in mind, however,

that the Doctor is not always—in the nature of things cannot even be often—waiting at the back of the door ready to fly to a case of emergency; and even supposing one or all of us are at home, valuable time may be lost before we can reach the scene. In such a case, the bystander, the member of the household, or the intelligent neighbour who can put to his hand, who knows what to do with a fit, how to stop bleeding, may at a pinch prove himself a tower of strength—for, truly, knowledge is power.

Before proceeding to discuss the various forms of accident and sudden illness I shall mention some general rules applicable to all cases.

1. From first to last retain your presence of mind. Keep cool—avoid fuss and excitement of all kinds. If you get nervous and hysterical you are worse than useless.

2. Send for the Doctor with as clear an account as possible of what is wrong, so that he may know to come properly prepared. The messenger should see the Doctor himself, not tell his message to a servant and then run away.

3. Let one person take command till the Doctor comes, and let the other bystanders

unhesitatingly obey his orders. Divided counsels are bad.

4. Remove the patient to a place of safety. If he is lying in the street lift him in the manner to be explained by-and-bye into the nearest house, or, if that is impossible, on to the pavement. If it be in the open country place him behind a hedge sheltered from the wind.

5. Form a wide circle round him with plenty of air space. If in the street, a crowd is sure to collect, and young Cupar is particularly ready to get in the way on such an occasion, so the bystanders should form a ring with joined hands to keep back the onlookers.

6. Lay him flat on his back, with the head slightly raised by means of a folded coat.

7. Keep him warm, if he is not bleeding, by throwing wraps over him and by means of hot bottles or irons, if these can be readily obtained. If he be bleeding keep him cold.

8. Unfasten anything tight about the neck or chest—such as the collar, necktie, and waistcoat.

9. If he seems very low, pale face, imperceptible pulse, and cold hands and feet, you may give a very little spirits or wine, but very little mind, only a few drops at a time.

If he is flushed and breathing heavily, spirits will do harm ; and never attempt to force drink down the throat of a person who is quite insensible.

These are the general rules which will be found to apply to nearly every case of sudden illness in the street, and certainly to every case of accident. But much more can be done in particular cases, and we shall now look at some of the most common of these.

We shall first discuss what can and ought to be done in cases of sudden illness, where, for instance, we have to treat various kinds of fits, and attacks of such alarming diseases as croup, bronchitis, diarrhœa, vomiting of blood, &c., and then proceed to deal with wounds, bleeding, and broken bones, illustrating these in the most practical manner, so that the least learned amongst you may know exactly what to do and how to do it.

I would only complicate matters, and serve to confuse you, were I to go into full details, and I therefore propose to confine myself to giving the plainest directions for treatment *till the Doctor comes*, for none of you need wish more information than will enable you to preserve life, give comfort, and save pain till help is obtained.

We shall have some practical illustrations

of accidents in the latter part of this lecture, but you will please bear in mind that no person is being hurt, that everything is simply make-believe, and that there is no occasion for alarm or for any of the gentle sex affording an additional practical illustration not in the programme by fainting.

Convulsion fits in infants may be caused by teething, worms, indigestion, fright, or may be the consequence of some other disease, such as measles or scarlatina, and in a few cases are merely symptoms of disease of the brain, or what is called water in the head. But no matter what the cause, as soon as a child is observed to be in a convulsion : blue about the eyes, nose, and lips, working the hands and feet, and, perhaps, frothing at the mouth, with the eyes either fixed or squinting, lose not a moment, plunge its feet into hot water, and at the same time apply a cold water cloth to the head. You have no time to be nice about getting a bath or a nice dish ; take the first thing that comes to hand, it may be a porridge pot or a soup tureen, fill in water hot enough to bear your elbow in just comfortably, and in with the little feet. In most cases you will be rewarded by hearing the little patient cry. Once a fit takes place, keep a sharp look out

for a few days for any return, and have everything in readiness to repeat the operation. I must here protest against the nonsensical fears many people have about putting their children into warm baths, or, what is the same thing, into warm water blankets. They say the child may die in it. So it may. A child may also die in its bed, but that is no reason why it should never be put in its crib.

Faint fits.—By a curious tendency of human nature to do those things which it ought not to do, many persons feel an almost irresistible inclination to laugh in church, and in church it is or in crowded meetings that we find the fainting sex generally go off. Fainting is simply temporary failure of the heart's action, and is generally produced by heat, want of ventilation, tight lacing, or indigestion. If the attack occurs in the neighbourhood of the nice young man of the village the case may be left to him with perfect confidence; but if it be a *bona fide* case of syncope, as it is termed, lay the patient on her back, with the head as low as the body, open her collar and loosen her dress, and if you have reason to suspect tight lacing, adopt the plan of the beadle mentioned by Dr Brown, "out with your gully

and rip her up." If she is not quite insensible the mere threat to do this may be sufficient to bring her to. You may also dash cold water in her face with a jerking motion so as to produce a series of shocks. Always remember that to set a fainting person upright in a chair may mean *sudden death.*

An epileptic fit or falling sickness is a more dreadful affection to look at. The open, staring, fixed, sightless eyes, the frothing mouth, and the rythmical motion of arms, legs, and perhaps head, render this disease unmistakable. As the tongue is generally bitten by the teeth, it is a good plan to stuff the corner of a towel or handkerchief between the teeth so that they cannot close; but beyond the general rules laid down at the beginning, nothing can be done during the fit. Your medical attendant should, however, be summoned, as he may be able to prevent a recurrence of the attack; for, now-a-days, many forms of epilepsy are quite curable.

Impostors sometimes imitate epilepsy for the sake of exciting charity. These froth at the mouth by chewing soap, and they do not hesitate to bite their tongue. You can generally diagnose this kind by running a sharp pin well into a tender part of the person.

True epileptics are quite insensible to pain, but the impostor will prove himself a lively edition of Mark Twain's jumping frog. Abernethy once saw an impostor in a fit in a grass park. "He is an impostor," said the great surgeon, "unless he is eating the grass." Whereupon the scoundrel immediately began ravenously munching the grass, and Abernethy turned away, observing that he knew now he was duping his audience. One cunning rascal is reported to have worn over his chest, so that it attracted attention directly his coat was unbuttoned, a large card with this memorandum, "I must not be bled. A glass of hot brandy and water revives me." Proposing to cut off the hair will often effect a speedy cure, or an ingenious onlooker may blow some snuff up the nostril, and change the fit into one of sneezing.

Hysteria is a condition of the nervous system frequently observed in the fair sex. Want of occupation, disappointment and vexation, especially when connected with love affairs, are active causes of this disorder. Hysteria may simulate any disease; but what is called a hysterical fit most usually is an imitation of epilepsy. There are convulsive movements, violent beating of the

breasts, with the clenched fists together, with shrieks and screams, and a sensation of choking, which is really due to flatulence. The attack ends with tears, crying, or laughter, and sometimes obstinate hiccup. The grand distinction between hysteria and epilepsy is that in the former there is no loss of consciousness—the patient is quite well aware of all that is going on, the eyelids are generally closed and twitching. I need scarcely say that the tongue is never bitten.

What are we to do here? Loosen the dress; make her swallow some valerian or assafœtida. The free application of cold water to the head and face, and over her bonnet—if that is a new one—will generally restore her at once. She will generally, at all events, recover the use of her tongue with surprising alacrity.

Afterwards the treatment is more moral than medical. Self-control and a taste of some of the real hardships of life will do more than gallons of physic.

More serious than such cases are those of *apoplexy* and *paralysis*, which are occasionally met with. The heavy snoring, sighing breathing, the flushed features, and total insensibility of apoplexy can only be confounded with profound drunkenness, and it is

indeed a very difficult point to distinguish between these two conditions. In both we have coma, but in drunkenness the patient can generally be aroused to momentary consciousness. Not so in apoplexy. Again the smell of drink may help us to form an opinion, but it must be remembered that a man may smell of drink and yet not be drunk. Hence policemen and others should be very careful. They should treat a doubtful case as if it were apoplexy till the doctor comes, and if the man is so drunk that he resembles an apoplectic, he equally requires treatment, and should have medical attendance at once.

What is to be done, then? Put him in a cool room. Keep the head raised, and apply cold by means of ice to the head, or a cold water towel.

I may do some good, perhaps, by mentioning some points which should be attended to by those who have a family history of apoplexy. Men and women who have large corporations, large heads, florid features, and short, thick necks—those, in fact, who have reason to believe they may have a tendency to apoplexy—should have gentle daily exercise in the open air without fatigue or strong bodily exertion; they should avoid excite-

ment of all kinds, tight neckcloths, stooping, and warm baths; frequent but spare meals, attention to the bowels, and washing the head with cold water every morning will also help; they should sleep on a high pillow, and on a mattress rather than a feather bed.

When they feel headache and giddiness, roaring noises in the ear and temporary deafness, a tendency to fall forward when walking, loss of memory and unusual peevishness, they may consider these symptoms as warnings, and a smart purge taken in time may ward off a fit.

Paralysis or palsy, or loss of power and feeling in one or more of the limbs, should be treated on general principles till professional help is obtained.

When a person is struck down by lightning, or has a sun stroke, the case is simply one of apoplexy.

Besides these fits, properly so-called, we may be present when a person drops down dead from heart disease or aneurism. Here the most skilful are helpless, nothing can be done but to break the sad intelligence as gently and as kindly as you can to the relations. Do. not beat too much about the bush, but have more consideration than Dean Ramsay's native of the Clyde who

undertook to break the news of her husband's death to the newly-made widow, and who did it in this considerate and sympathising fashion—"Ye're man's drooned, whaur'll we pit him?"

And I would wish to say further that when a man is taken ill on the street, make as little fuss as you can. Carry him into the nearest house, and wait. Don't carry the poor fellow home on a shutter, and thereby make his friends suppose that something very dreadful has happened, when possibly his stomach is merely out of order.

Supposing a person to be suddenly seized with a pain in the stomach or bowels, colic, diarrhœa, or dysentery, you can seldom go wrong in administering 14 or 20 drops of laudanum, or, better still, chlorodyne, and at the same time applying a hot poultice either with or without mustard. A turpentine stupe answers very well in these cases—wring a flannel out of hot water (in a towel to save your hands from burning), and sprinkle a tablespoonful or two of spirits of turpentine over it. Do *not* give pills or castor oil without medical advice, as the case may be one of inflammation, and a purgative will assuredly play mischief.

Be careful how you give laudanum or chlorodyne to children.

Vomiting may often be relieved by the same applications, and the internal administration of ice and soda water.

Vomiting blood, even a basinful or two, is not nearly so serious a matter as it looks. Keep the patient in a cold room with plenty of air, in bed, lying on his side, so that the blood may come away easily. Give ice if you have it. Apply ice or cold water cloths to the stomach. Give two teaspoonfuls of vinegar, and one teaspoonful of Epsom salts in a wineglassful of cold water, and repeat this every half hour till the Doctor comes.

Spitting blood is an affection that should never be trifled with. It differs from vomiting of blood, in that it is coughed up in mouthfuls, and looks frothy. The best plan will be to keep the patient cool and quiet till help is got, but till that arrives you may give a teaspoonful of vinegar every half hour in a little cold water.

Bleeding from the nose, unless very abundant, need not usually alarm you. Let the person sit upright, dissolve a little alum in water, and squirt it up the nostril. Keep the arms high above the head, so as to lessen the supply of blood to the nasal cavities. You can also apply cold by means of a towel wrung out of cold water to the spine, and to

the nose itself. A cold key sent down the back answers very well; but there is sometimes a little difficulty in recovering it.

Croup is inflammation of the windpipe, and is easily recognised by the brassy sound of the cough, like the crowing of a cock. As soon as you hear this in any of your children give a vomit immediately—a teaspoonful of fresh ipecacuanha wine (which should always be kept in every house where there are young children) every five minutes till the child vomits freely; help its action with a little warm water, and, if necessary, by tickling the throat with a feather. At the same time, put the feet into hot water with a little mustard in it, and wrap a plain oatmeal or linseed meal poultice round the throat. Of course, whilst you are doing these things the Doctor has been sent for, and when he comes faithfully carry out his orders.

Nothing is more vexing and disheartening —after visiting the little patient in the middle of a cold winter's night, and, perhaps, lying awake for an hour or two after getting back to bed—to find in the morning that your most important prescription—very likely a hot bath or blanket—had been neglected. Some old woman thought it was not safe to faithfully carry out your orders, but there is

no time to lose in so serious a disease, and the neglect of what seems to you a trifle may mean the death of your child.

Bronchitis may be treated in much the same way. By placing your ear to the back of the child's chest you will hear the wheezing which once heard is so unmistakeable. A valuable medicine in bronchitis and all other complaints where there is a cough is to have a kettle boiling on the fire with the spout sticking ont a little, so that the steam may enter the room.

In cases of *poisoning* endeavour at once to produce vomiting by large draughts of warm water and mustard. Also try to protect the stomach by giving milk, chalk, magnesia, sweet oil, or white of egg. And do not let the patient go to sleep. Parents should be very careful not to leave poisonous things lying about—matches, rat poison, and such like. All medicines should be thrown out when done with, and such drugs as laudanum and paregorie, as well as all liniments, should be kept under lock and key.

Burns and *Scalds* are of very frequent occurrence, and vary from a slight blister to the most fatal injury of the whole body. Every fire where there are children should be guarded so that they cannot get near it,

otherwise, with the natural curiosity of infantile humanity, they are certain to pull a pot of broth or the hot-water kettle on to them ; or their clothes may catch fire. When any one is on fire and their clothes burning in a blaze, panic seizes them, and as a rule they rush out to the fresh air, which is the worst possible thing to do. The intelligent bystander should immedistely seize the person, throw him, or her (generally her), on the ground, and wrap her up in his coat, or a shawl, or a rug, or a blanket, and keep her tightly enveloped. Then get water and soak the clothing thoroughly, for although the blaze is out, the half-burnt and singeing clothes are eating into her flesh. Keep her in a warm room, lay her on a table or on the floor—*not the bed.*

In all cases of burns and scalds remove the clothes gently and tenderly. Use large, sharp scissors or a sharp knife, and do not try to save anything. Cut off boots, stays, stockings, flannels in the way most likely to save pain, and without regard to their future value. If any part of the clothing is sticking in cut round it and let it remain, and do not burst any of the little blisters. Now soak a piece of old linen in linseed oil and lime water and apply it to every burnt

part. But carron oil may not be at hand. Hot water and milk, equal parts, with a little carbonate of soda added will do for the time. The principle is to keep the part warm and protected from the air.

Foreign Bodies.—Children have in their ignorance an unhappy way of introducing small articles—peas, beans, slate pencil, small stones, and such like into the ear and nose. You are better to get your medical attendant to remove these for you, but there can be no harm in putting a pair of scissors into the nostril, and opening the blades, when very likely the foreign body will drop down. It is not very prudent to push with pins or hooks either in the ear or nose, as you are likely to push the thing farther in. A pinch of snuff will sometimes, by exciting sneezing, answer your purpose. If an insect get into the ear, fill the ear with oil, and the animal will die immediately. Peas and such like can generally be got out of the ear by syringing with warm water.

Bits of meat or potatoes, fish bones, artificial teeth, may get caught in the throat, and threaten death by suffocation. Lose not a moment, place the head well back, and introduce one or two fingers into the throat. Keep well to the back of the throat, and you

can do no harm, most likely you will be able to catch hold of the substance, or what is the same thing be able to thrust it down the throat. A bent tablespoon passed down answers very well. Slapping the back often suffices, but should not be trusted to if not successful at once. Do as I tell you, and some of you will have the satisfaction of saving a life.

You must remember that, from the tearing of the mucous membrane, after a fishbone has been in the throat, there is often the sensation of its being still there after it has been removed.

If a child has swallowed a coin, a bit of slate pencil, or a button, remember *never to give medicine.* Feed him on arrowroot gruel, well-boiled porridge, and such like food which will form a coating round the substance, and see it safely through the whole intestinal canal. The great thing is *not* to give a dose of aperient medicine which is the first thing most mothers fly to, and which has proved the death of many unfortunate victims of affectionate ignorance.

Foreign bodies, dust, flies, eyelashes, &c., may get into the eye, and should be removed at once by means of the corner of your handkerchief or a piece of folded paper.

Syringing the eye with a little warm water gives great relief, or a few drops of sweet oil answer the same purpose. Most masons are very smart at picking out particles of stone from the eyes of their mates.

Sprains or twists of the muscles or joints are very painful accidents, and are long in being healed. It is in these injuries that bone-setters delight, and in which their greatest successes occur. Their first proceeding is to mention a good number of small bones to be "out" (it is of no consequence whether the bones really exist or not), and then by rubbing and pressure cause a crack of some of the tendinous or ligamentous structures about the joint, and declare they are in. So powerful a thing is faith that their patient immediately feels much better.

You might think me guilty of professional jealousy were I to say more on this subject, so I shall leave you all to judge for yourselves whether a knowledge of anatomy can be hereditary; and if you think you are safer in the hands of a bonesetter than in those of a man who has spent years in studying his profession, so be it.

The treatment of sprains is, in the first place, rest and bathing with hot water, and, as soon as the swelling subsides, gentle exer-

cise. It does not do to keep the joint at rest too long, as stiffness is apt to come on.

Bruises—a familiar example of which is a black eye—are caused by the rupture of a blood vessel under the skin. Anything cold applied externally—raw beef, coins, hammer—mitigates the discoloration. When that is stopped warm fomentations are best.

Bites and *Stings.*—Stings—the business ends of wasps and bees—should be extracted when they are seen sticking in the skin. Afterwards a little oil or glycerine over the seat of injury will give some relief.

Bites of cats and dogs are generally dreaded, not so much from their own intrinsic severity as from the fear that they may be followed by hydrophobia. The danger is real, but not so great as is generally thought, and there are some popular fallacies very prevalent on this subject. A dog to cause hydrophobia by its bite must be mad or rabid at the time of the bite. It is all nonsense to suppose that should the dog go mad at any subsequent period the person previously bitten will also go mad, and consequently the poor dog is shot at once. A dog which has bitten any one should *not be killed* but *kept and watched to see if it be mad.* If it shows no signs of

rabies the person bitten may make his mind quite easy. The poison of a mad dog is in the saliva, and, therefore, if the teeth have to pass through the clothing they are wiped clean and no bad results ensue. Then, it is not a good plan to rush to the nearest druggist and have caustic applied to the wound. By the time that is done the poison, if it be there at all, is in the blood, and you only make the wound more difficult to heal. The best plan, whether the dog is mad or not, is to suck the wound carefully with your lips and let it bleed freely.

Suffocation, or the deprivation of air to the lungs, may be caused in many ways—by drowning, by gas in the house or in a coal mine, or by being buried underneath rubbish. Total deprivation of air cannot be endured without fatal results for more than two or three minutes, but in all cases we should persevere in our treatment as long as the slightest spark of life can be perceived, and certainly as long as the heart continues to beat. And our first endeavour must be in the direction of getting fresh air into the lungs. First, then, clear away all mud, stones, and articles of clothing from the mouth and nostrils, draw forward the tongue, and see that there is no tight cloth-

ing about the chest. Place the patient on his back, and support the head and shoulders on a small cushion or folded coat. Grasp the arms just above the elbow, and draw the arms gently up until they meet above the head, and keep them there for 2 seconds, then turn them down and gently press them for 2 seconds against the sides of the chest.

FIG. 17.—Artificial Respiration—Promoting expiration.

FIG. 18.—Artificial Respiration—Promoting Inspiration.

Repeat these measures fifteen times per minute till a spontaneous effort at breathing ismade. Whilst doing this keep rubbing the chest and face briskly, and dash hot and cold water on them alternately. This is artificial respiration. There have been cases of recovery after suspended animation of five hours—so persevere.

In cases of hanging, suicidal or accidental, cut the person down without delay, and proceed with artificial respiration.

Wounds. — These vary from a mere scratch to the severest injuries. A simple form of wound is caused by tramping on needles, glass, or splinters of wood, or by running a fish hook, crochet needle, or thorn into the hands, feet, or face. Never attempt to withdraw a crochet needle or fish hook backwards. Go to a Doctor and get it cut out. Needles, glass, and splinters or nails, should be removed at once if that can be easily done; and the wounds should not be closed, but rather kept open, so that any particles left may be thrown out. Needles sometimes travel all over the body, and may appear on the surface far from where they entered the body. You should get advice about these at once.

Cuts are chiefly serious from the danger

attendant on shock and on the loss of blood, and, of course, if that be great you will send for help at once. But I trust that after this lecture none of you will be afraid at bleeding, or be ignorant as to what to do. The grand secret—the simple way to stop bleeding from a cut or wound is *pressure*. Bear in mind always that bleeding is very easily stopped, and should have no terror for any of you. Well, how is pressure to be applied? Suppose the head is wounded. You will have a deluge of blood, for scalp wounds bleed profusely. Keep calm; wash away the blood, fold up a pad, soak it in cold water, and place it over the wound, and apply a bandage over it—a handkerchief or scarf will do.

Suppose, however, it is from a wound in an arm or a leg. *Pressure* again must be *used.* First stop the circulation in the limb by encircling it above the wound by a bandage—a handkerchief or scarf will do—tie a stick in it, and twist it round till the bleeding stops. If the arm is wounded, carry it on your head; if the leg, lie down and support the foot on a chair. If you are by yourself with no help near, take a handful of dry earth, put it on the wound and grasp it tightly. Common whiting or pipeclay answers the same purpose.

A wound of the hand is often troublesome from the profuse bleeding, but this can be easily arrested by binding a bandage round the wrist, and then placing over the wound pipeclay or flour, and securing these by a handkerchief.

In all cases of bleeding, the grand principle is to arrest the circulation at a point nearer the heart than where the blood is flowing.

[These measures were all illustrated with the help of five assistants, one of whom acted the part of patient, and the others the parts of attendants on the sick man. In the same way the readiest modes of treating broken bones, with appliances ready procurable anywhere, were shown in a practical manner. The lecture concluded with the formation on the platform of a stretcher, on which the injured man was carried away.]