Health of body in relation to alcohol / By William Snodgrass.

HEALTH OF BODY

IN RELATION TO

ALCOHOL.

BY

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PREFACE.

THE following is the substance of three lectures, which were delivered at the request of Sir WILLIAM COLLINS, and with the permission of the Glasgow School Board, to the advanced pupils in several of the Glasgow Public Schools. In these addresses the aim has been to give a brief account of several of the leading processes by which the body is maintained in strength and vigour, and to show why neglect of the laws of health, and more especially the habitual use of intoxicants, is followed by disease and unhappiness.

The lectures were illustrated by various diagrams and experiments, which have not, however, been referred to in detail.

As many of the facts mentioned were quite new to the children, it was necessary that they should be stated in the simplest language possible, and it has been thought that the effect of the lectures would be strengthened if the children were supplied with the following brief statement of the subject in printed form; while it would also enable those who wish to write papers on the subject, to show to what extent they had profited by the lectures.

W. S.

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INTRODUCTION.

ALL living beings have certain wants that must be supplied, and are constantly undergoing certain changes so long as they are alive. If they obtain what they need, and if the necessary changes go on freely and naturally, their bodies are said to be in a healthy condition; and, on the other hand, if the body is deprived of the things it needs, or if the processes upon which life depends are interfered with to any great extent, the body becomes unhealthy, diseased.

Let us then, in the first place, inquire what we must have or do in order to live at all—what things are essential to life.

Things Essential to Life.—Firstly, we must have air to breathe. If a person be prevented from breathing for about five minutes, life will be extinct. Breathing is necessary for many reasons, but more especially for two—viz., the inhalation or taking in of oxygen gas from the air and the exhalation or breathing forth of carbonic acid gas brought from all parts of the body to the lungs by the blood. Then we must have food to eat and water to drink, and our bodies must be kept warm.

But suppose these wants to be satisfied. Suppose we have plenty of fresh air and plenty of nourishing food, we must further have the power of making these things our own, of taking these lifeless matters into our bodies, of building up from them the living substance of our bodies, and finally we must be able to rid the body

of certain substances formed at its expense whenever any action is performed. For we know that with every movement of any part of our bodies, whether in walking or running, in breathing, or in the beating of our hearts, in speaking or thinking, or any other act of the mind, there is always a change in the vital, living substance of our bodies. There is a breaking down of their highly complex material, and simpler substances are formed which must be cast off, and which if retained would as speedily and certainly injure the body as poisons swallowed by the mouth. Many of these substances, for example, are given off from the skin in the sweat or perspiration. Thus it is that cleanliness is so essential for health. If the skin is not kept clean the little passages or pores by which the sweat passes out are blocked, and the waste substances are pent up in the body and do it harm.

The skin, then, together with the kidneys, has a most important work to do in the separation of solid and liquid impurities from the body. But there are also harmful gases formed in the body and given off from it, for the most part, by the lungs. We may perhaps understand this better if we take a simple illustration. We know that when a piece of coal has been put into the fire and become heated, it flames, a little smoke may perhaps be seen passing up the chimney, and when the coal has burnt done, a few cinders or ashes may be seen at the bottom of the grate. The ashes are waste substances that we can see. But there are other waste substances formed that we cannot see, gases which have passed off up the chimney. The formation of such gases can easily be proved if we burn a candle in a long glass vessel, and prevent the air from entering freely. The candle consists of a wick and of some fatty substance such as tallow or wax. Now, fats are not simple, but complex substances, and chemistry has shown that they may be broken up into three substances which cannot be broken up into simpler substances—namely, carbon, hydrogen, and oxygen. But the air in which

the candle burns consists of a mixture of several gases, the most important of which are oxygen and nitrogen, and of these two oxygen is the gas which is concerned in burning. The carbon of the candle unites with the oxygen of the air, and forms carbonic acid gas; while the hydrogen of the candle unites with the oxygen of the air and forms water. But if the air be not admitted to the vessel the flame will soon go out, because all the oxygen has been used up, and if now a little lime water be poured into the jar, the water will become milky in appearance from the union of the lime with the carbonic acid gas, forming chalk.

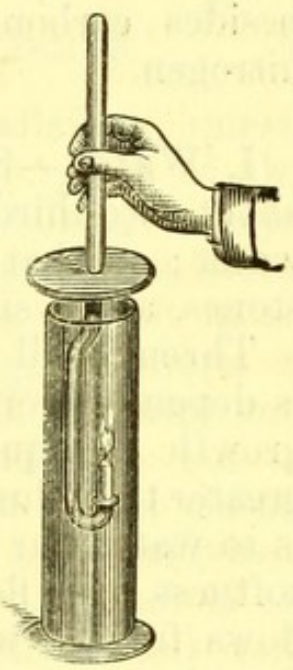

Fig. 1.—Arrangement to show the formation of carbonic acid gas and water when a candle burns.

Now, a precisely similar process occurs in our bodies. Almost all the substances used as food contain carbon and hydrogen. These elements unite in the body with the oxygen which has entered through the lungs, form carbonic acid and water, and thus heat is generated, and the warmth necessary to life maintained. And not only is heat so obtained, but also the power of doing work. For, as in the steam engine, the heat obtained from the burning of coal or gas is utilised in boiling water and generating steam, and the steam, in turn, gives power to the engine to do work, so in our body the oxidation of its elements gives us energy, and within certain limits the greater the call upon the body the greater will be the change in its substance, the amount of heat generated, and the waste products requiring to be got rid of. If, then, this loss be not counterbalanced by our taking a necessary amount of food, the body will become thin and weak, and unable to do work.

In order to replace these waste products, the food must contain substances similar in kind to those of the body,

and investigation has shown us that these may all be conveniently grouped into four great classes, namely—(1), *water*; (2), *mineral* substances; (3), *carbonaceous* substances, or those containing carbon, hydrogen, and oxygen; and (4), *nitrogenous* substances, or those which, besides carbon, hydrogen, and oxygen, also contain nitrogen.

I. Water.—Surprising as it may seem at first sight, about two-thirds of the weight of the body consist of water; so that if, for example, a man's weight is nine stones, about six of these are water.

Through all the realm of nature we find that vitality is dependent on the presence of water, and during active growth the quantity of water in the body is usually greater than during maturity. It is to water our tissues owe their softness and flexibility. Blood flows from a wound because it contains water. Our muscles will contract because they are kept pliant with water. Three-fourths of the brain substance is water. Even bones and teeth contain a measurable amount of water, inasmuch as they are living parts of living bodies. If any part is completely dried it becomes lifeless and rigid.

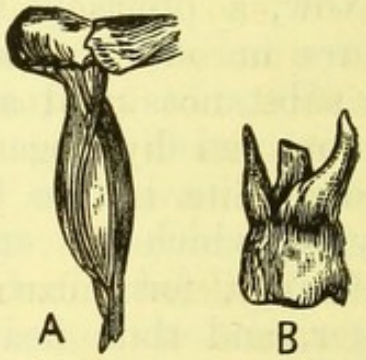

Fig. 2.—A, muscle attached to bone; B, tooth; all three during life contain water.

Our food must be dissolved in, or moistened by, water before we can swallow it; it must be soluble in water before it can be taken up into the blood; the blood must have much water to flow freely to all parts of the system, and water is essential for the removal of the waste products of vital activity. When the body is deficient in water we feel thirsty, and water is the only substance which can quench our thirst. Not that we must necessarily drink pure water to allay our thirst. We may instead use substances which contain water, such as juicy fruits, soups, milk, or other beverages. In a pound

of oranges or grapes, for example, there are about fourteen ounces of water, in a pound of turnips about fifteen ounces of water, in a pound of potatoes about twelve ounces of water, and the same in lean beef.

WATER IS THE ONLY NATURAL DRINK.

Water, then, is the only means of allaying thirst. Alcoholic beverages allay thirst only in virtue of the water which they contain. For pure alcohol has a great affinity for water, and if brought in contact with living tissues will remove water from them so quickly as to destroy their life. Instead of quenching, therefore, it only increases thirst, or if taken in small quantity and mixed with much water, its ultimate effect is not to leave men satisfied, but to create an unnatural thirst, which leads to the introduction of more than the necessary amount of water into the body. Alcohol is an artificial, not a natural drink, and as such is used only by man, its discoverer, and by no other member of the animal kingdom.

II. Mineral Substances.—Of these, common salt may be taken as a type. In the preparation of food, common salt has usually to be added in order to make the food palatable, but the desire for salt depends not on taste, but upon a natural want of the body. Digestion is retarded if common salt is absent, and in countries remote from the sea, we find that animals require salter food than in maritime regions. Salts of potash and lime are also indispensable, and there is always a small quantity of iron salts in the body. Such substances are necessary not only to give firmness to the bones, but also for the healthy action of all parts of the body; and if they are absent or deficient in the food, we find such diseases as rickets or scurvy making their appearance. Fortunately, most animal and vegetable foods contain the amount of salt required by the human body, the deficiencies of one form of diet being made up for by the

presence of the required substance in another. Thus we find that beef contains about five per cent. of these mineral substances, eggs about one and a half per cent., and milk about three quarters per cent.

III. Carbonaceous Substances.—These consist of the fats, sugars, and starches. As already pointed out, the heat and energy of the body are mainly due to the oxidation of these substances, and the greatest amount of heat is gained from the fats. It may be shown that the burning of one pound of fat produces as much heat as that of about two and a half pounds of sugar. Hence it happens that fats are more esteemed as articles of diet in cold climates, while sugars and starches are more used in tropical countries. But fats not only add to our warmth by their oxidation, but also by their protective power. For immediately below the skin there is a layer of fat of varying thickness which, being a non-conductor of heat, serves to keep up an even temperature, and where warm blooded animals are exposed to great extremes of cold, this layer is very thick, as in whales, seals, and animals living in Arctic regions.

The quantity of starch in the body is not very great, because it is for the most part converted into sugar during the process of digestion. There is, however, a form of starch called glycogen, which is found in small quantity in all the tissues of the body. Although we cannot by artificial means convert starch into fat, we know that this can be done in the body, for animals will grow fat on starchy foods. Carbonaceous substances can thus be stored up in the body for future requirements.

The starchy elements of food are for the most part derived from the vegetable kingdom, as from potatoes, wheat, rice, etc. From the same source we gain most of our sugars. Alcohol is also a carbonaceous substance, being derived from the sugar of grains, of fruits, or of vegetables. Under the influence of fermentation the sugar is broken up into alcohol and carbonic acid. Being a carbonaceous substance, we should expect alcohol to

burn, and so it does. Hence it is urged that when taken into the body it is a source of heat. And no doubt this is partially the case. Part of the alcohol is given off unchanged, and a part of it is oxidised in the body. Hence it serves as the source of a certain amount of heat; but, as will be shown, alcohol causes other changes in the body which lead to such a loss of heat that the small amount gained from oxidation is very far from compensating for the amount of heat lost. So well is this known that alcoholic drinks are not used now by Arctic explorers, for it is a fact proved by long experience that those men resist the cold best, and are able to do the most work, who take no alcohol. This applies to all climates.

As the result of numerous experiments, it has been found that more work and better work can be done by men when abstaining from, than when taking, alcohol. Soldiers bear fatigue better without it, and athletes refrain from it while in training. When, then, a man takes a glass of spirits to keep out the cold, he is in reality opening the door wider to let the cold enter. Far more true warmth and power for doing work are got from a glass of milk than from a glass of spirits.

IV. Nitrogenous Substances.—These are substances which contain nitrogen in addition to carbon, hydrogen, and oxygen. They constitute the main ingredient of all forms of flesh. Without them growth is impossible, for from them all the actively vital parts of the body are built up. They are present, therefore, in every diet.

Of the many varieties of nitrogenous substances only a few need be mentioned. One typical form is to be got in white of egg, which is the store of food set aside for the young chick, and closely allied to it is the nitrogenous substance found in blood. Glutin is the name applied to the nitrogenous substance found in grains, while in milk, cheese, etc., there is found a rich store of nitrogenous substance called casein. Since these substances

contain carbon and hydrogen, it is to be inferred that in the changes they undergo in the body a certain amount of heat is produced, but their main duty in the body is to build up its structure.

The amounts of nitrogenous matter in various important articles of food may be mentioned to give some idea of their relative richness. In every hundred pounds of cheese there are about twenty-eight and a half pounds of nitrogenous matter, and were it as easily digested as other nitrogenous substances, cheese might form the main staple of diet. In lean beef there are nineteen pounds to the hundred; in eggs, fourteen; in bread, eight; in milk, four; and in potatoes two pounds per hundred. On the other hand, none of the ordinary alcoholic drinks contains more than about a half per cent. of nitrogenous matter; so that a glass of milk really contains at least eight times as much flesh-forming substance as a similar amount of any of the ordinary alcoholic beverages. When, therefore, a man is asked to take a little wine or whisky to make him strong, it is well for him to pause before following the advice.

How has the idea arisen that strength is given by such liquors? It is because the wine or whisky acts for a brief period as a stimulant to the bodily energies. Just as the horse works harder for a short time when the whip has been applied, so the body makes a call upon its reserve forces, and is thereby weakened as a whole. Then comes the secondary effect of the alcohol, which is depressant, and this, superadded to the weakened condition of the body, intensifies the feeling of fatigue. There is thus a brief period of energetic action and a lengthened period of fatigue, and the fatigue is greater than it would have been had a similar amount of work been done without the aid of the alcohol. If we wish, therefore, to put forth a prolonged effort, and to bring all the powers of the mind to the work in hand, the only true and natural way of becoming able to do so is to increase the strength with nourishing food, and to save the brain from the disturbing influences of alcohol.

Such being the substances required for nourishment, let us next consider how we introduce them into the body; how we build up from these lifeless materials the living substance of our bodies, and what effect alcohol has upon these various processes.

As all parts of the body are constantly undergoing change and waste, there must be a constant supply of nutritious matter. This matter is supplied to the tissues by the blood, and its store of nourishing material has to be replenished from the food. But before food can pass through the walls of the alimentary canal into the blood, it has to be in a liquid condition—dissolved in water.

DIGESTION.

This melting of the food, then, is the process known as digestion. Let us note the main changes in foods in the order of their occurrence. In the first place, food is usually cooked, so as to render its elements more friable, that is, more easily separated from one another, more accessible to the digestive fluids, and more pleasant to the taste. When taken into the mouth it should be well chewed, so as to be finely divided and thoroughly mixed with the saliva (spittle). Neglect of the teeth, and of careful chewing of food, are fruitful causes of indigestion, for the starch of food cannot be taken up or *absorbed* by the blood until it has been changed to sugar, in which condition it can melt in water. This change is effected by a ferment present in the saliva, called ptyalin. This ferment, however, only acts for a short time after swallowing, and its activity is soon entirely stopped in the stomach, so that, unless the process has been well begun in the mouth, the starch will remain unchanged in the stomach, and give rise to feelings of discomfort or pain. Hence we find many people complaining of discomfort after taking a meal of porridge and milk, because the porridge is swallowed with the help of the milk without admixture with saliva,

and thus its starchy elements are unaffected in the stomach.

Similarly it is a great mistake to take much liquid—tea, for example—along with bread, for we are apt to make the tea do the softening work of the saliva, while it cannot change the starch to sugar. It is still worse if alcohol be taken, for even a very small percentage of alcohol, much less than is present in ordinary beer, is sufficient to arrest the action of the ptyalin, whether in the mouth, or, after swallowing, in the stomach, while there is the further drawback that alcohol renders the paste, which starch makes with water, denser and less soluble.

A simple experiment may be mentioned, which shows the influence of alcohol in preventing the change of starch to sugar. Take two cups half-full of water, and float on the water thin pieces of cork in which

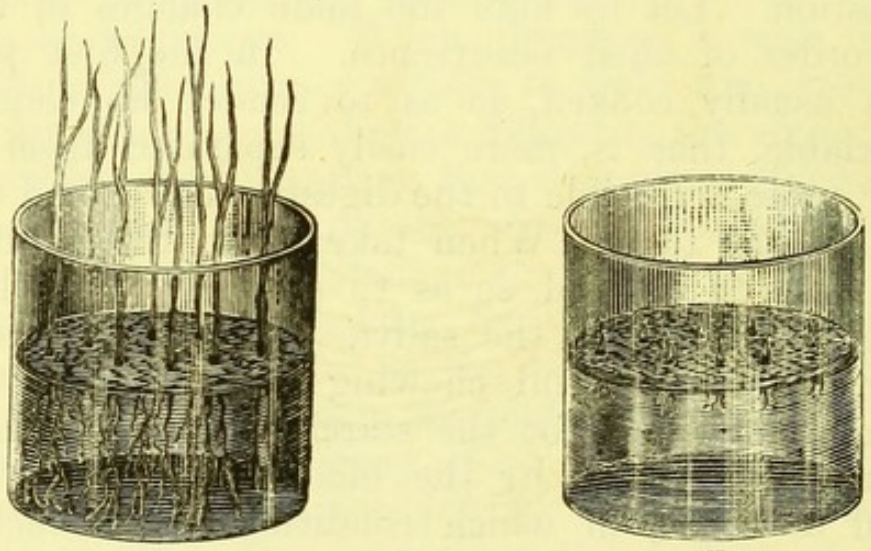

Fig. 3.—A, wheat growing in water; B, growth of wheat stopped by the addition of alcohol.

small holes have been bored. Place upon the corks some grains, say of wheat, and set the cups in a warm place. In a few days it will be found that the grains have sprouted. If now a teaspoonful of spirits be added to one cup, the growth of the wheat will be at once stopped, for the alcohol prevents *diastase* (the ferment in growing grain), from changing starch into sugar, and the young

plant is starved. The action of alcohol on all young growing things is alike hurtful. If alcohol be given to kittens or puppies, it quickly stops their growth or kills them outright.

When the food has reached the stomach, certain parts of it may at once pass through the inner coating of the stomach, into the network of fine blood-vessels which cover its surface. Thus water, with salts and sugar dissolved in it, may be immediately absorbed into the blood. And now the stomach begins its work. Its surface, formerly of a pale, grayish-yellow colour, becomes pink from a sudden afflux of blood, and a clear fluid soon begins to ooze from its walls. This fluid—the *gastric* juice—contains three substances which deserve special attention. In the first place, it contains a

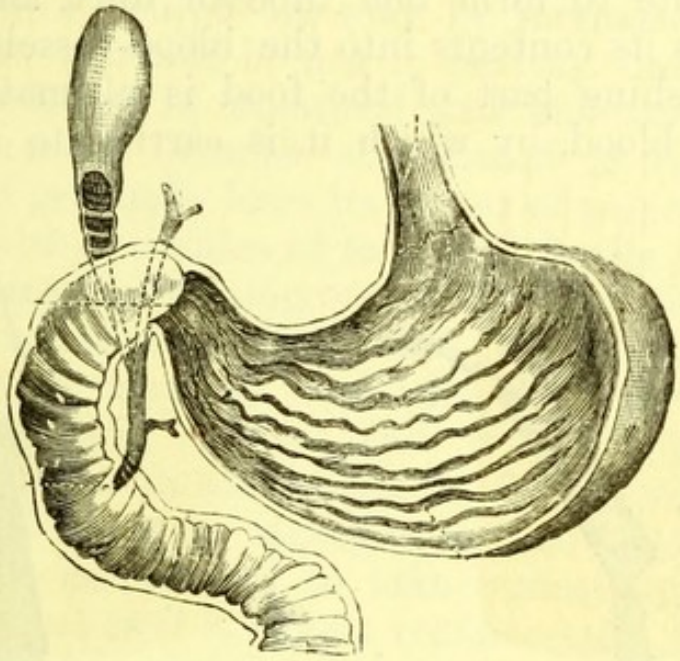

Fig. 4.—Showing the Stomach, the Duodenum, and the Gall Bladder.

little acid, which stops the change of starch to sugar, dissolves certain mineral substances, so that they may be at once absorbed, and causes many nitrogenous substances to swell up and become like a jelly. Secondly, the gastric juice contains a ferment which acts upon the nitrogenous substance of milk, and renders it digestible. Thirdly, it has a ferment called pepsin, which acts upon all nitrogenous substances, and makes

them soluble in water, so that they are made ready to enter the blood.

There is an opening from the stomach into the bowels, which, during the earlier period of digestion, is kept tightly closed by a muscular ring. But after a time, when the food in the stomach has been partly digested, this ring begins at intervals to relax, and allows the half-digested food to pass onwards from the stomach into the bowels. Here it meets with several other fluids, viz., the bile, the pancreatic juice, and the intestinal juice, and by these the process of digestion is as far as possible completed. The nourishing material is removed from the contents of the bowels, and either passes through the walls of the bowels into the blood-vessels directly, or else into little tubes known as lacteals, which unite to form one tube or duct, and this tube discharges its contents into the blood-vessels. Thus all the nourishing part of the food is ultimately mingled with the blood, by which it is carried to all parts of the body.

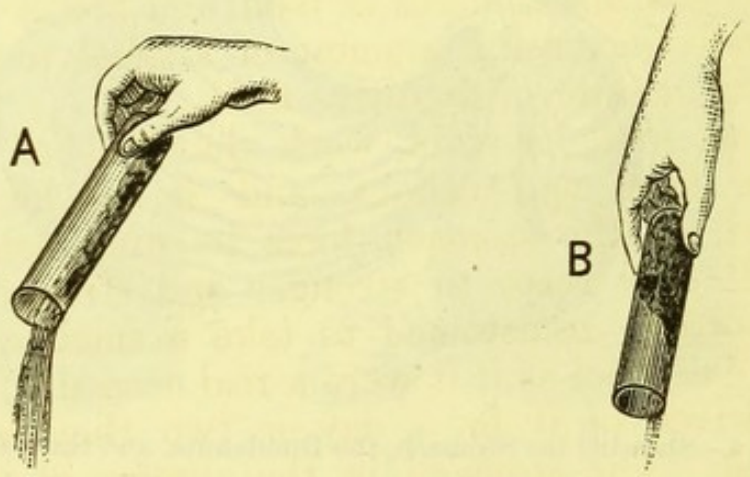

Fig. 5.—Nitrogenous substance—white of egg; A, melted in water pours easily from the tube; B, hardened in alcohol will not pour readily from the tube.

Effect of Alcohol on Digestion.—How does the presence of alcohol affect these processes? In the first place, it can be easily shown that alcohol will not dissolve salts or sugars or starches, and so can only retard their absorption. Next, it hardens or coagulates nitrogenous substances, and so renders their change and

absorption more difficult. As with the ferment of saliva, so in the stomach it arrests the action of the pepsin, and consequently must retard digestion. Finally, it exercises a hurtful action on the stomach walls.

Effect of Alcohol on the Stomach.—If a few drops of alcohol be placed on the skin and prevented from evaporation, a redness will quickly appear, and then inflammation. So in the stomach the vital power is impaired, and the stomach walls prevented from doing their work so well as they would without it. Alcohol cannot coagulate them as it did the lifeless nitrogenous substances, for they are living, and able to resist its action. To do this, however, they must summon to their aid fresh supplies of blood. Thus the amount of gastric juice poured out may be increased, but the cause of the increase is not a healthy one, as with ordinary food, but is unnatural and unhealthy. Then when the stomach becomes accustomed to the presence of alcohol, it gradually loses its power of response to the ordinary healthy stimulus of food, and finally it requires a gradually increasing amount of alcohol to obtain the necessary amount of digestive fluid.

Just as with constant work the skin of the hands becomes hard and callous, and is no longer easily blistered, so the stomach loses its finer sensitiveness, and will only react to stronger and stronger stimuli. Hence, people accustomed to take a small quantity of alcohol daily feel as if it were a real necessity, for if they are deprived of it for a day or two they feel ill and wretched. The stomach, in the absence of its wonted stimulus, will not work so well, but fortunately it happens that the stomach has great power of recovery, and if abstinence is persisted in for a few days or weeks the natural tone is regained, and the supply of gastric juice will be accommodated to natural needs. The rate of return depends, of course, to some extent on the general health, for if the whole system has been reduced in strength, it cannot be expected to regain its former

vigour all at once. But there are very few cases in which the use of alcohol cannot be left off at once and entirely, not only safely, but also with speedy and marked benefit to the general health and comfort.

One reason for the fact that the stomach may not be permanently injured is that alcohol, when mixed with water, passes rapidly out of the stomach and into the fine meshwork of blood-vessels with which the inner coat of the stomach is supplied. These soon unite to form a large vein which carries most of the nutritious material absorbed from the stomach and bowels to the liver, in the substance of which the blood-vessels subdivide and branch until the blood is again flowing in a meshwork so fine, that the blood comes into close contact with the liver tissue, and is changed in many ways.

Effects of Alcohol on the Liver.—It is this arrangement which explains the well-known fact that in habitual drinkers—and more especially in gin-drinkers—the liver suffers perhaps more than any other part of the body. Such degeneration as this is the more to be deplored, because the liver plays a most important part in working

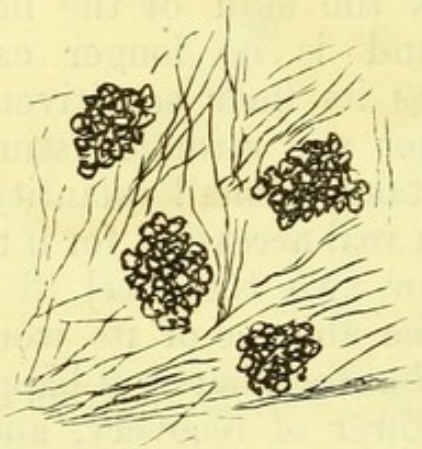

Fig. 6.—Liver tissue, showing fatty degeneration from action of alcohol.

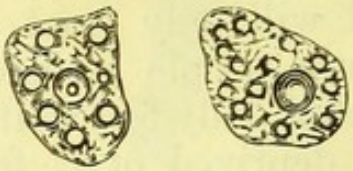

Fig. 7. — Gin-drinker's Liver Liver shrunken and destroyed by chronic inflammation.

up the elements of food into a form suitable for use by the body, and also because the liver is always busily engaged in separating from the blood waste products which, if retained, give rise to all manner of depressing

feelings, and ultimately to most serious forms of illness. The blood never being properly purified, the liver substance itself may undergode generation, and we may find that its elements have become loaded with minute drops of fat, which cannot but interfere with its activity, or we may find another change.

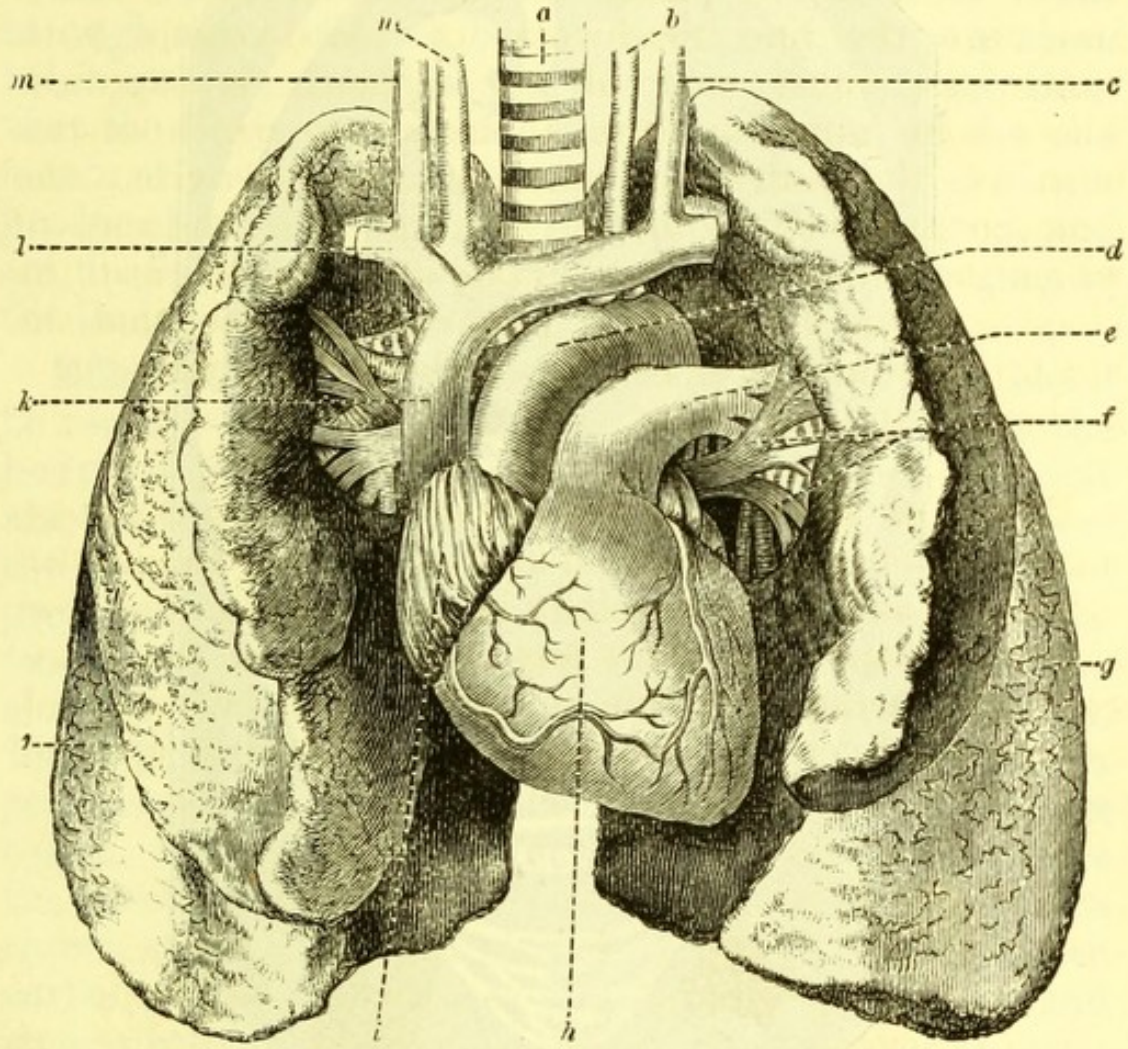

Fig. 8.—Lungs and Heart. *a*, windpipe; *b*, *n*, vessels through which blood goes to the head; *c*, *m*, vessels bringing blood from the head; *d*, vessel through which blood passes to the body; *e*, vessel through which blood goes to the lungs; *f*, vessels bringing blood back from the lungs to the heart; *g*, *j*, lungs; *h*, *i* heart; *k*, *l*, vessels bringing blood from the upper extremities to the heart.

The connecting material which binds the elements of the liver together undergoes chronic inflammation, then shrinks, and much of the liver's working substance is destroyed or rendered inactive. This is more especially the case with those who are in the habit of taking alcohol in the morning, or when the stomach is empty,

when the alcohol exercises its full power unimpeded by the presence of food stuffs.

The Circulation of the Blood.—After passing through the liver, the blood is collected again and sent direct to

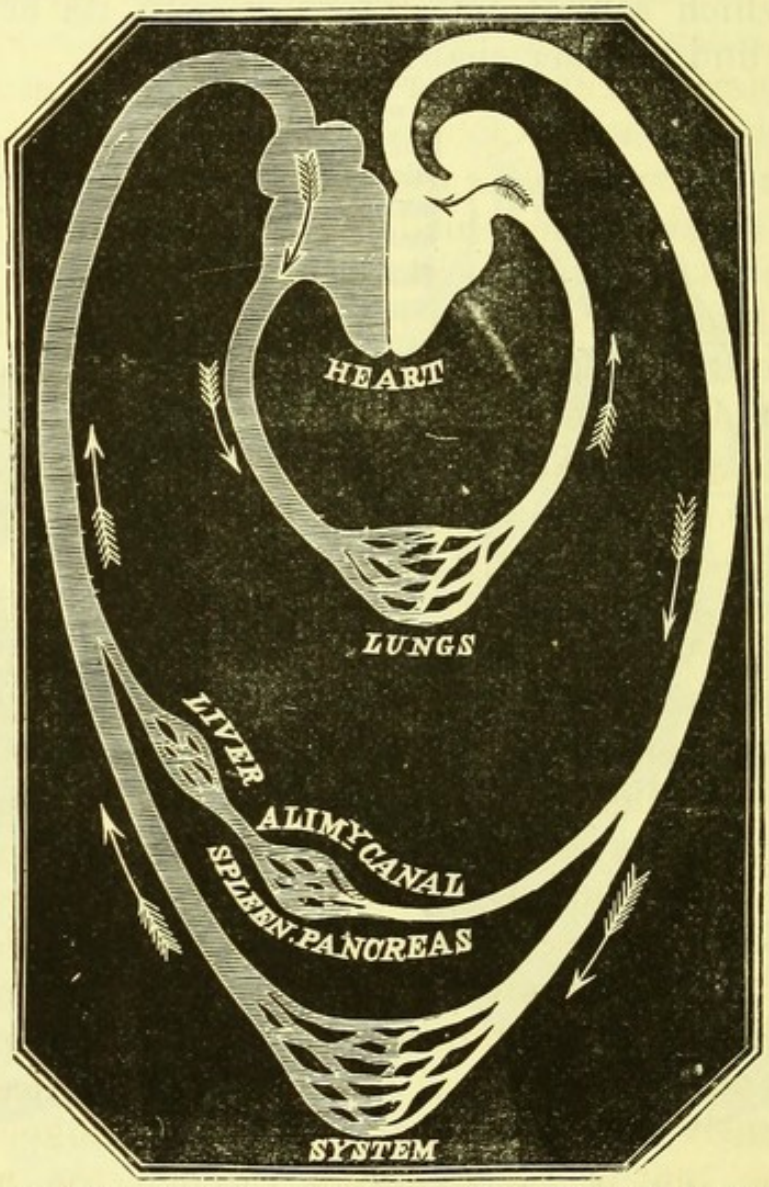

Fig. 9.—Diagram illustrating the circulation of the blood; the arrows show the direction of the blood-stream.

the heart, where it meets the dark red impure blood coming from the rest of the body. Now, the heart is a hollow muscular organ divided into two completely separate chambers by a partition passing through the middle from above downwards. The impure blood comes to the right side of the heart, and is from it sent directly to the lungs, where it becomes pure by giving off the carbonic acid gas with which it is laden,

and is enriched with a fresh supply of oxygen from the air taken into the lungs in breathing. It returns from the lungs bright red in colour, to the left side of the heart, from which it is now sent out to all parts of the body, bearing food and air to the very minutest parts.

The blood-stream never leaves the system of tubes through which it flows, but in their finest divisions these tubes are so fine, so close together, and their walls so thin, that the fluids of the blood can pass out to all the elements of the body. In like manner the waste products produced in the body can be returned to the blood, and are finally removed from it by such excreting organs as the lungs, liver, and kidneys.

Effects of Alcohol on the Blood.—Should the blood be rendered of poorer quality, it will be seen that the body will be imperfectly nourished. We have seen that alcohol tends to coagulate or harden the soft elements of the food. We have now to note further that alcohol prevents the oxygen of the blood being given up so readily to the body. As oxygen is indispensable to tissue change, we find a double injury thereby produced. There being less tissue change or oxidation, less heat is produced, less energy for work, and the person feels colder, feebler, more weak and depressed when once the alcohol has produced its effect. It has also been shown that blood containing alcohol does not part with carbonic acid so readily as blood free from alcohol, and consequently the blood of the habitual drinker is never so pure as that of the abstainer. Then, too, the tissue changes having been imperfect, the waste substances formed are not so soluble in water, nor so easily got rid of as those produced when there is more oxygen given up, and so impurities gather.

Thus it is, for example, that the carbonaceous substances—the starches, sugars, and fats—being imperfectly used up, we are apt to find fatty degeneration of many parts of the body which may become bloated, but which, so far from being stronger, is really more open to

disease, and, as surgeons well know, less able to withstand any sudden shock or depressing influence.

The Nervous System.—We have seen how the blood is sent flowing to every part of the body, and we know that this blood-stream must go on flowing without cessation during life. But what is the agency by which this unceasing motion is kept up? The heart acts as a pump sending on the blood, but what is it that makes the heart itself go on beating? It is the action of the nervous system.

Let us consider shortly what the nervous system is, and what it has to do in the body. Enclosed in the hollow of the skull is a mass of greyish-white substance called the brain. From the under surface of this there passes a prolongation called the spinal cord, down through a passage in the back bone. The brain and spinal cord form what is called the central part of the nervous system. From them there pass out to every part of the body fine strands or fibres of matter called nerves, and it is through the means of the brain, spinal cord, and nerves that all the actions and feelings and thoughts of a man are regulated and carried on.

Thus, *e.g.*, there are nerves passing to the brain from the nose, by means of which we are enabled to smell; others again pass from the eyes, and without them we would be blind. Others pass from the ears, by means of which we may hear; others from the mouth, giving us the sense of taste; others from the whole surface of the body, through whose aid we can feel.

But not only is sensation possible through nerve fibres passing to the brain, but there are other fibres by which messages pass out from the brain to all parts of the body calling these parts into action when required. Thus, in the brain the resolve may arise that the hand is to be raised. The message goes out through certain nerves to the muscles that lift the arm, they contract, and the arm is raised. Cut these nerves or destroy certain parts of the brain or spinal cord and the arm could no longer be raised. It would be paralysed, and would hang motion-

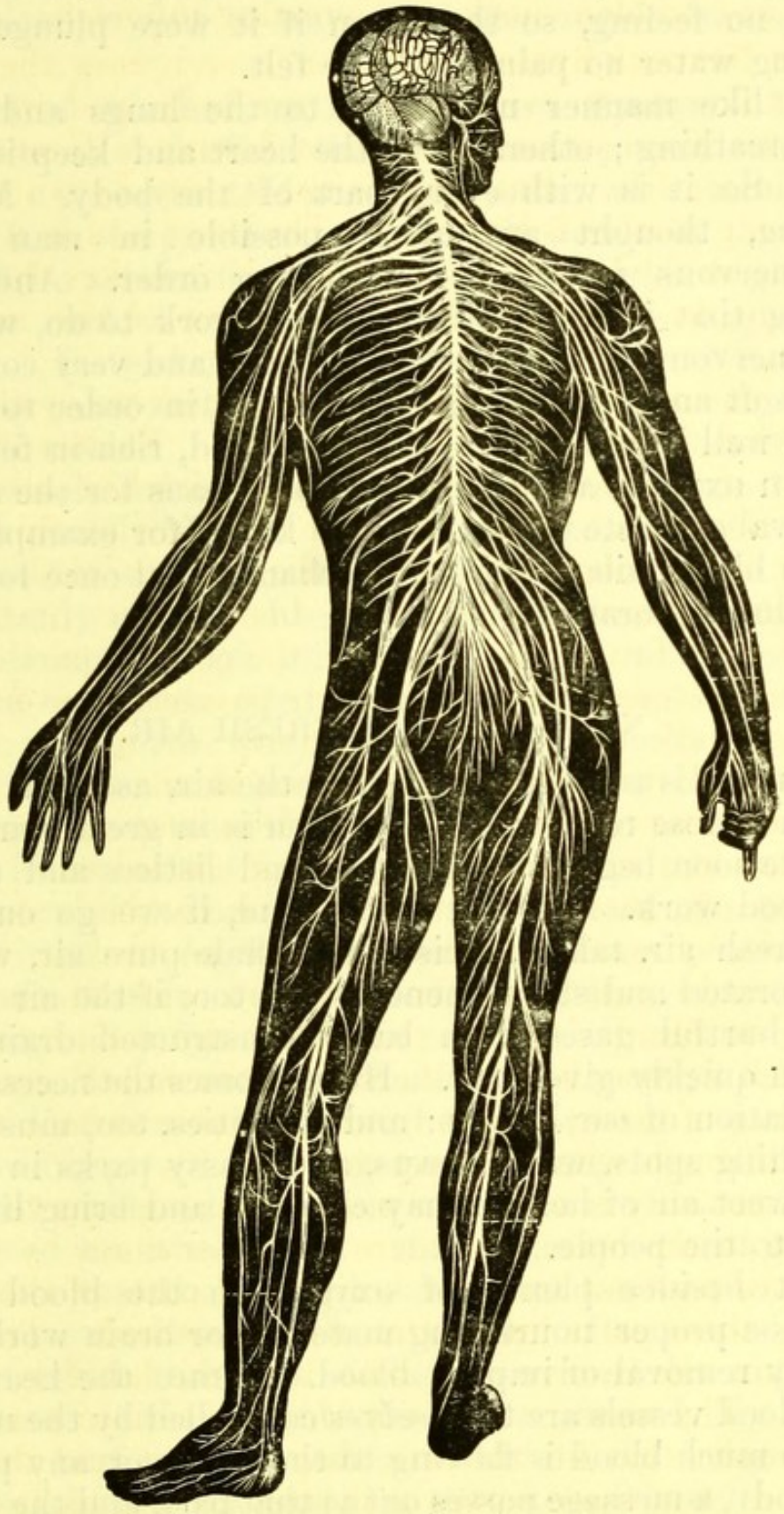

Fig. 10.—Nervous System, showing Brain, Spinal Cord, and Nerves

less by the side, while, at the same time, the arm would have no feeling, so that even if it were plunged into boiling water no pain would be felt.

In like manner nerves go to the lungs and guide the breathing; others go to the heart and keep it beating. So it is with every part of the body. Motion, feeling, thought are alone possible in man when the nervous system is in working order. And now, seeing that it has such important work to do, we find that nervous matter is very delicate and very complex. It is soft and pulpy to the touch, and in order to do its work well it must have plenty of blood, rich in food and rich in oxygen, and there must be means for the speedy removal of waste products. We know, for example, that if the blood fails in purity, the change is at once followed by a loss of brain activity.

NECESSITY FOR FRESH AIR.

If there is too little oxygen in the air, as when people sit in a close room and the oxygen is in great part used up, we soon begin to feel heavy and listless and unable for good work. On the other hand, if we go out into the fresh air, take exercise and inhale pure air, we feel invigorated and strengthened. So, too, if the air is foul with hurtful gases from badly constructed drains, the health quickly gives way. Hence comes the necessity of ventilation of our houses; and our cities, too, must have breathing spots, wide streets, and grassy parks in which the sweet air of heaven may circulate and bring life and light to the people.

But besides plenty of oxygen in the blood there must be proper nourishing material for brain work, and speedy removal of impure blood. Hence the heart and the blood vessels are themselves controlled by the nerves. If too much blood is flowing to the brain, or any part of the body, a message passes out to that part, and the blood-vessels contract, and thus allow less blood to be sent; or, again, if more blood is required, the heart may be made

to beat faster, and the rate of the flow being increased, more blood is sent to any particular region in a given time.

Effect of Alcohol on the Nervous System.—How, then, does alcohol affect the brain and nervous system? Alcohol acts upon the nervous system as a narcotic; it puts it to sleep. A strange result arises in the first stage of its action, for just as the nerve action begins to fail, the control of the small blood-vessels begins to be lost. Instead of remaining at their natural healthy size, they relax and allow more blood than usual into the smallest vessels. Thus the skin flushes, because the little vessels have become distended with more blood than is usually there. More blood, too, is sent to the brain, and the brain for a very short time becomes more than usually active. Ideas flow faster, there is a feeling of well-being through all the body; the wheels of the machine have been oiled, and it works more freely and rapidly. But this very rapidity soon works its own destruction, for with the increased quantity of blood to the brain comes more alcohol, and its action on the nerve matter is intensified. And now we begin to note how those parts of the brain become first affected which have to do with those higher qualities of mind and soul which distinguish man from the brute creation. Imagination and reasoning and judgment begin to fail, and the lower passions begin to get the upper hand. Not seeing so clearly the dividing line between right and wrong, a man will more readily give way to anger or foul language, will fight or do other misdeeds which he would never think of doing were he in his sober senses. How often is it heard in our law courts that the accused was a most kindly and affectionate man when free from drink! Then comes the stage in which that part of the brain which controls the movements of the body begins to be affected, the limbs refuse to perform their office, and the man staggers or falls; ask him to do anything that demands delicacy of touch or steadiness of hand, as, for example, to lift a pin, and he fails, partly because his sense of touch is so

blunted that he cannot feel the pin; partly because he cannot grasp the pin between thumb and fingers.

Now the muscles of the mouth and throat lose their masters and refuse to work, speech becomes thick or fails; or, again, the muscles lose control of the eyes, the two eyes do not work together, and the man sees double. Then as the brain becomes more deeply affected the senses fail, or, in other words, the man loses for a time the power of sight, hearing, etc., and becomes unconscious. As a rule, he now falls into a deep sleep, during which the alcohol is thrown off from the body, and the man regains his senses. But sometimes, if he has taken a large quantity of alcohol quickly, those parts of the brain which control the action of the heart and lungs are put to sleep. Then the lungs stop breathing, and the heart stops beating, and the man dies. It is fortunate that, as a rule, however, a man becomes what is called "dead drunk"—that is, unconscious and unable to drink any more—before the brain is so affected that he dies from drink.

Such is the effect of alcohol on the brain, the extent to which a man is affected being in proportion to the amount and kind of drink taken. If taken only in small quantity, and at long intervals, the body can throw off its evil effects entirely. But if a man persists in taking it day after day, then every part of his body begins to suffer, because the blood itself—the source of life to all other parts of the body—is polluted.

As has already been stated, blood containing alcohol will neither give up its carbonic acid so easily nor will it take up so much oxygen as blood without alcohol; or, in other words, the body is living in impure instead of pure air. Then the smaller blood-vessels fail to preserve their proper size, and the result is seen in the red nose and purple cheeks. The blood vessels of the skin being thus distended, more hot blood comes to the surface than should, and so more heat is lost than the body can spare, and the drinker takes more spirit to get warmth, which only increases his loss. But with loss of heat

comes loss of power to do work. Hence we find that people in very cold climates find themselves warmer and abler for work without alcoholic drink than with it. The muscles, by whose action work is done, are weaker if alcohol is present in them than if they are free from alcohol. It has been found that men set to do steady work can do more and with less fatigue if they take no alcohol.

ADVANTAGES OF ABSTINENCE.

The abstainer, too, has fewer risks, and many insurance companies are so well aware of this that the rate of insurance is much less for a total abstainer than for one who calls himself even a moderate drinker. It is for the same reason that men who engage in any contest requiring strength and steadiness of hand and eye do best without alcohol. The hand is steadier, the eye is truer, the judgment more reliable. The finest oarsmen, the greatest pedestrians, the best marksmen join in condemning the use of alcohol before any trial of strength or skill. And just as the blood and muscles and nerves are injured so other parts suffer. The heart is weakened by the undue strain that is thrown upon it, the brain may give way, and it is well known that alcoholic indulgence, next to hereditary influence, is the most frequent cause of insanity.

While alcohol thus injuriously affects the healthy action of every part of the body, it has been more especially found that young growing animals are peculiarly susceptible to its influence. Growth is retarded or stopped, healthy action is weakened, and the craving for the repetition of the stimulus more quickly and strongly felt. Hence, the younger a person is the more likely is he to be permanently injured by the habitual use of alcohol. One of the best resolves a lad can make is to be an abstainer from every kind of alcoholic drink He will find himself, as a man, healthier, stronger, happier than his friends, who, as lads, acquired drinking habits, and not having the depraved taste, he will be more able and

ready to hold out a helping hand to those who have fallen under its influence. The man is to a great extent controlled by the habits formed in youth. Every habit leaves a definite mark, either for good or evil, upon the body, and the longer a habit is cultivated the more difficult does it become to shake it off. This is especially true of the use of alcohol. It is far wiser, therefore, to do without alcohol altogether, and those who abstain in youth will find it easy to do so when they grow older, they will have more true enjoyment in life, and will be in a better position to guide others in the right way.

QUESTIONS.

1. What things are essential to life?
2. Why is cleanliness necessary for health?
3. How is carbonic acid gas formed in the body, and how is it given off?
4. How is the body made and kept warm?
5. What are the four kinds of things needed as food?
6. Why is water necessary for the body?
7. Why cannot alcohol take the place of water in the body?
8. In what different ways may we quench thirst?
9. Name some of the mineral substances in the body.
10. Why are mineral substances needed in the body?
11. Name several kinds of carbonaceous substances suitable for food.
12. Why do we need carbonaceous substances in food?
13. Why does the body become cold after taking alcohol?
14. Give examples of nitrogenous substances required for food.
15. Tell the amount of nitrogenous substance in 100 lbs. of cheese, of lean beef, of eggs, of milk, of beer.
16. Why does alcohol make a man weak?
17. What is the use of digestion?
18. How is starch digested, and how does alcohol prevent its digestion?
19. How is growth affected by alcohol?
20. How is food digested in the stomach?
21. How does alcohol hinder digestion in the stomach?
22. How does alcohol hurt the stomach?
23. Where does food pass to from the stomach?
24. How does alcohol injure the liver?
25. How does the blood circulate through the body?
26. What changes take place in the blood in the lungs, and how does alcohol hinder those changes?
27. Explain the effects of alcohol on the blood.
28. Explain the saying that a man with alcohol in his blood is living in impure air
29. What is meant by the nervous system?
30. What is the work of the nervous system?
31. Where is the brain lodged, and what is its appearance?
32. What does the brain need in order to work well?

33. How does the nervous system control the heart and the blood vessels?

34. What is the effect on the brain when more blood comes to it than is usual?

35. How does alcohol really paralyse while it seems to stimulate the brain?

36. Why does alcohol make a man stagger?

37. Why does alcohol make a man unconscious?

38. Why does alcohol sometimes kill a man very quickly?

39. Why is fresh air necessary?

40. Explain the effects of alcohol on the brain.

41. State some of the advantages of abstinence.