Lay Supplement No. 13



# HOW ALCOHOL AFFECTS THE BODY

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## The Lay Supplements Series

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# HOW ALCOHOL AFFECTS THE BODY

DRINKS which contain some alcohol are used by a great many people. Most people drink only small amounts at a time. A jigger of whisky (1 ounce), or a glass of wine (2 to 4 ounces), or a bottle of beer (12 ounces), contains about half an ounce of alcohol. Some people drink somewhat larger amounts, and others drink a great deal at a time. Alcoholic beverages sometimes cause people to behave in strange ways. This is commonly seen. Less easily seen is the fact that some drinkers—those who often drink very large amounts, particularly—come to serious bodily harm.

Because most drinkers do not suffer any bad effects from their use of alcoholic beverages, many people think of alcohol as completely harmless. Others, however, look on alcohol as nothing but a poison for man, and they point to the bodily and mental disorders which some drinkers develop.

The truth of the matter is well known to scientists who have studied this subject at great length. Those who are willing to lay aside any notions about what alcohol ought to do to the drinker, or any beliefs about what it ought not to do, can learn the scientific facts. Some of these facts are given in this pamphlet. But space allows us to deal here only with the prompt effects of alcohol on the body. This means, what happens in the body fairly soon after drinking moderate amounts of alcohol, or even large amounts if drunk only on rare occasions. The effects of heavy drinking over a long time—that is, the medical complications and disorders of alcoholism—are dealt with in another pamphlet, though they will be mentioned here from time to time.

## WHY ALCOHOL MAKES PEOPLE DRUNK

THE human body is made up of millions of tiny cells of different types. Each cell is alive and has a job to do, in combination with other cells. Living cells use nutrients—food—from which energy or work is gained. A group of cells of one type is called a tissue—for example, nerve tissue, connective tissue, muscle tissue. Different kinds of tissue have different special jobs and uses. Each kind can be disturbed in its work by many happenings—for example, by lack of the right kind of food, or by exposure to great heat or cold. A group of tissues may be combined in certain ways to make up an organ, as the heart or the liver.

The human body is very efficient because its different tissues and orgs work together, in a systematic way, to do special jobs. Each organ d pends on the work of the others. If one of them is damaged or d ordered, the others will also suffer.

The most important effect of alcohol is on the brain. How can th organ be disturbed by alcohol? And how does that interfere with t work of other organs of the body? It will be easier to understand t if we consider what happens to the brain under a kind of trouble w which many people are now familiar.

*Flying Too High.*—When a man goes very high up in an airpla he is likely to "black out"—he becomes unconscious, his mind becom a blank. This happens because the higher one goes in the atmosphe the less oxygen there is in the air. The cells of the body all need oxyg for their work. The oxygen is brought to the cells by the blood, whi takes it up from the lungs as the man breathes. The shortage of oxyge high up, is felt by all the cells of the body. But one type of tissue is pa ticularly sensitive to lack of this element: nerve tissue. Thus, it is t brain which suffers first and most when the man does not get enou oxygen.

Here is what would happen to a man who went higher and high up in a plane without getting a supply of extra oxygen. First, his jud ment would be damaged. Judgment, knowing when and why and ho to do one thing rather than another in different conditions, depends o the highest brain center. This center, the most highly developed pa of the human brain, is the most sensitive to lack of oxygen.

Next, the man becomes unable to govern the movement of h muscles in a co-operative way. He may sway or wobble if he tries t walk. His hands may move awkwardly, and not work together as team. His tongue and lips will stumble as he tries to talk, especially he tries to say words he does not commonly use. This failure of team work by the muscles grows more and more severe as the plane ris where there is less and less oxygen. The failure is not due to the shorta of oxygen supplied to the muscle cells. For them, there is still enoug But the brain, which directs the organized, systematic actions of t muscles—their teamwork—is not getting enough. And the brain be comes a poorer and poorer director as it gets less and less oxygen. I efficiency is cut down.

If the plane keeps on rising, the man will finally black out—he becomes unconscious. Then the most highly developed part of the brain, the part which does the directing, stops working. At even higher altitudes, with still less oxygen, more of the brain centers become "knocked out."

What would happen if, before too long, the flyer were brought back to an atmosphere with enough oxygen? He would recover his senses and his muscle control fairly soon. He might have a headache and feel ill for some hours, but there would be no permanent damage to his body or any of its organs. The disorder he suffered was a disturbance of "function"—an interference only with ability to work.

But what if the plane keeps going higher, so that the oxygen shortage becomes ever more severe? Finally even the brain center which controls breathing quits. Then the chest muscles no longer receive the nerve signal which keeps them moving. The man stops breathing. He now gets no oxygen at all. After a few minutes the cells of the heart fail. It stops beating, and soon the man is dead.

*Intoxication.*—This illustration of what happens to a man cut off from a normal supply of oxygen is worth bearing in mind because exactly the same series of symptoms sets in when a person drinks more and more alcohol than his body can take care of at one time. This does not mean that alcohol cuts off the supply of oxygen. Alcohol acts directly on the brain to disturb its ability to work. But when alcohol reaches the brain tissue, the result is similar to what happens when that tissue is deprived of oxygen.

After a certain amount of alcohol reaches the brain, the man's judgment becomes impaired. As more alcohol gets there, he becomes unable to organize the movements of different muscles in teamwork. This muscle disharmony becomes more severe as more alcohol reaches the brain. Finally, with still more alcohol, the man loses consciousness. And if, under certain conditions, enough added alcohol should reach his brain after he is unconscious, he may die.

## ALCOHOL AND THE BRAIN

How does alcohol get to the brain? When a man drinks an alcoholic beverage, the alcohol passes into his blood stream, mainly through the walls of his small intestine. The circulating blood brings the alcohol to

the brain, as well as to all the organs and tissues. But the strength alcohol that reaches the different organs—the heart, liver, kidneys brain—is very small. This is because the alcohol that the man drank diluted hundreds of times by his blood. Here again the analogy w the man in the plane will be useful in understanding what happens.

Say a man of average size drinks 3 ounces of ordinary whis quickly. When diluted in his body, this will give about 0.06 per c alcohol in the blood—that is, 6 hundredths of 1 per cent, or 6 pa alcohol to 10,000 parts blood. This is not enough to damage the tissu of heart, kidney, liver or brain, just as the shortage of oxygen is n enough to injure those organs. But this small proportion of alcoh like the shortage of oxygen, is enough to interfere a bit with the wo of the highest brain center—and only that part. And the result is, as the case of the man slightly deprived of oxygen, that his judgment impaired. He may, for example, behave improperly. Suppose he drin more—enough to raise the alcohol strength in his blood higher. The the next stage of impairment is reached. Poor muscle control will seen. Speech may be slurred. Hands may not work well together. Fe may wobble. The man may stagger or fall, perhaps be unable to ris It depends on just what strength of alcohol has reached the brain Finally, if the alcohol reaching the brain is enough to equal 0.40 p cent in the blood—that is, 40 parts in 10,000—the man will lose co sciousness. He is dead drunk—though far from dead. It takes mo than a pint of whisky for an average sized man to become so drunk.

Now imagine that the man swallowed an enormous amount of al cohol—say a quart of whisky—rather quickly before passing ou Though he becomes unconscious, the alcohol in his stomach and in testine keeps on passing through into his blood stream. The strengt of alcohol in his body thus keeps on rising, even though he is no longe drinking. After the alcohol strength in the blood reaches 0.50 per cen —50 parts in 10,000—he is in deep coma and therefore in serious danger of death. Nearing 1 per cent alcohol in the blood (100 parts in 10,000 the breathing center in the brain becomes paralyzed and death will surely follow shortly.

What happens if the man does not drink so much, but just enough to become mildly or severely drunk? Or even if he drinks enough to become unconscious, but no more? Why doesn't alcohol add up in people who drink only a little, but many times?

As the alcohol circulates in the body, it is used up (oxidized) in the same way as food. A man of average weight can ordinarily use up the amount of alcohol in about an ounce of 100-proof whisky in an hour. This produces energy which the body can use for its needs. The body, then, is working all the time to destroy the alcohol, converting it to harmless materials.

But the body can thus oxidize only a limited amount of alcohol in any given time. If alcohol is taken in at a faster rate than the body can take care of it, the un-oxidized excess accumulates in the blood stream and tissues. The amount which thus accumulates causes the disturbance in the work of the brain which was described above. After drinking stops and all that was swallowed has passed into the blood stream, the continuing oxidation steadily reduces the alcohol in the blood. Then the signs of drunkenness disappear in the reverse order of their appearance.

After the alcohol has been used up, the man will feel no effects if he drank little. If he drank a great deal so quickly as to get a large accumulation of alcohol in his blood stream, and thus became severely intoxicated (drunk), he may have hang-over signs—headache, upset stomach, and other symptoms of illness. But after these disappear, usually in a matter of hours, the man's body is normal again. There was no permanent damage to the brain or other organs. Only the brain's ability to work efficiently was disturbed. This caused other organs to be out of order to the extent that the brain failed to direct their work with efficient signals.

This, then, is one way in which alcohol acts on the body. If a man drinks enough at one time to raise the level of alcohol in his blood to about 0.05 per cent (5 parts in 10,000) his brain begins to show the effect. This effect is the same, actually, as if he took a little bit of an anesthetic—like ether. Alcohol acts on the brain just like an anesthetic. But it is a question of the amount that reaches the brain. The more alcohol, the stronger the effect—that is, more of the brain is put to sleep, going from higher to lower centers. The efficiency of the brain is restored, in reverse order, as the body uses up the accumulated alcohol. The organs of the body suffer no permanent damage from this temporary experience.

One mistaken notion of the past is worth mentioning at this point. It used to be thought that, since alcohol can dissolve some fats, the way

it produces its effect on the brain is by dissolving the fat (the lipoid) in the brain cells. We know that an alcohol solution of 1 drop in 100 (1 per cent) would not dissolve anything that water alone wouldn't. Therefore we know that alcohol cannot work by dissolving the brain lipoid—for if it got to the brain in a strength of 1 per cent, the man would die.

There are, of course, other results of getting drunk—for example social effects. But these are not dealt with in this pamphlet.

*Relaxation and Sedation.*—In describing the effect of alcohol on the brain it was not possible to avoid stressing the element of drunkenness. But the great majority do not usually drink so as to get drunk. In small amounts alcohol causes only a mild sedation; this means that slight pains or fatigue cannot be felt. Alcohol does not cure them, but by its action of damping the keenness of the brain a bit, it makes the man less able to feel them. He thus feels relaxed, less tense. And this effect of small amounts of alcohol on the brain may account for most people's use of alcoholic beverages, whether or not they know it.

## OTHER ORGANS

In order to simplify the description of the most important action of alcohol—its effect on the brain, especially in causing intoxication—we have spoken as if this were the only action. Now we may describe some other effects, and some incorrect notions about them.

*The Stomach.*—A small amount of alcohol, such as may be taken in one or two drinks, tends to increase the flow of juices in the stomach and to start the mild activity of this organ which is often felt as hunger. Thus alcohol may be said to act as an appetizer. In a man with ulcers the added flow of juices would be harmful.

If the drink is taken as a strong alcohol solution—say 20 per cent alcohol or more, as in fortified wines or distilled spirits—the contact of the alcohol with the throat, gullet and lining of the stomach, as it first goes down, may cause an irritation, felt as a stinging or burning of these tissues. The alcohol is quickly diluted by the juices of the stomach so that the irritation stops. Some very heavy drinkers, people who often drink large amounts of strong alcoholic beverages, have a chronic inflammation of the lining of the stomach. This gastritis may be caused

by the constant irritation with strong alcohol solutions. Other organs—the liver or brain, for example—cannot be irritated this way because the alcohol is diluted, to far less than 1 per cent, before it gets to them.

*The Kidneys.*—In spite of all old notions, alcohol is not particularly damaging to the kidneys. It does increase their urinary activity. Recent studies indicate that this is not caused by direct action of alcohol on the kidneys but by its effect on the pituitary gland. This gland is a small extension of the lower part of the brain. One of the materials which it produces, and releases into the blood stream, controls the formation of urine by the kidney. As alcohol reduces the activity of this gland, the kidney forms more urine.

*The Glands.*—The fact that alcohol can lessen the activity of the pituitary gland has already been mentioned. This gland takes part in many important bodily activities by supplying chemical materials which control those activities. It influences the work of other very important glands—the thyroid and the adrenals. It influences growth and sex development. Does the temporary suppression of a part of this activity by alcohol have any permanent damaging effect? From all the evidence of research thus far it appears that occasional drinking, or even regular drinking of small amounts of alcohol, does not cause such damage. The frequent drinking of large amounts is another matter and may be harmful to these and other glands.

Recent experiments with animals have shown that injection of large doses of alcohol causes the adrenal glands to discharge their secretions. These little glands, located atop the kidneys, are very important in helping man to meet the stresses and strains of life. They are known to shoot off their chemicals into the blood stream in case of sudden fright or shock, for example. Thus, the sudden intake of a large amount of alcohol may be a strain, causing the adrenal glands to discharge. Again, there is no evidence that the body is impaired if this happens once in a while, since it is organized to meet such emergencies. But it is suspected that repeated severe demands on this gland over many years may exhaust its ability to work.

The adrenal glands also take part in many other body activities—for instance, the distribution of minerals in the body. All or some of these activities may be altered while a man is drunk. As far as is known,

the normal state is restored in hours to days after the intoxication we off, depending on how severe it was.

It used to be thought that the sex glands were especially subject damage by alcohol. Old superstitions blamed all sorts of defects children on the supposed drunkenness of their parents. The child were thought to inherit weak or crippled minds or bodies because seed of their parents had been injured by alcohol.

Actually, drinking alcoholic beverages cannot damage the sex glan or the seed cells. This can be understood if the manner in which alc hol reaches these tissues and cells is recalled. The alcohol first enters t blood stream and is vastly diluted. Even in severe drunkenness, t alcohol strength that reaches the glands or seed cells is not likely to as much as ½ of 1 per cent. Yet if an alcohol solution of 1 per cent we applied directly to those tissues and cells, they would not be harme Thus the old notions about children of drunken parents being born d fective can be cast aside, together with the idea that alcohol can d rectly irritate and injure the sex glands. Again, the result of years heavy drinking, or the effects of the alcoholism of parents on the heal and welfare of growing children, are other matters, to be discussed other pamphlets.

The seeming stimulation of sex activity by drinking is not caused b any effect of alcohol on the sex glands. It results from the action of a cohol in putting to sleep that part of the brain which controls certa kinds of behavior. Very large amounts of alcohol reduce sex activi in the same way as they lessen all activity—by making the drunke man unable to carry out planned actions, or by putting him to slee

*The Liver.*—In very severe intoxication, usually in a long bout o heavy drinking, the liver is likely to become swollen and tender (acu hepatitis). The drinking of a large amount of alcohol may cause th sugar stored in the liver (as glycogen) to move out into the bloo stream. It may have the same effect on other materials stored by th liver—for example, vitamin A. As far as is known, these shifts of ma terials are not injurious. Some of them may help the body to meet th strain of intoxication—that is, to offset the effects of alcohol.

The liver is not directly irritated or injured by contact with th greatly diluted alcohol which reaches it after even heavy drinking. The liver, in fact, plays a leading role in handling alcohol for the body

It is in this organ that the first step takes place in the change of alcohol from an intoxicating substance to harmless materials. But prolonged heavy drinking is likely to lead to serious liver disease. That, however, is one of the medical complications of alcoholism.

*The Water Balance.*—That alcohol has a drying effect—that it can draw water out of certain materials—can easily be shown. But this is true only of pure alcohol. The demonstration of this effect has caused some people to believe that the alcohol in beverages does the same thing in the body, drying out the cells. This notion has been used also to "explain" the thirst felt in the hang-over after severe intoxication.

Laboratory experiments have shown that what actually takes place in the body after drinking is not a withdrawal of water but a shift in its position. The body is about two thirds water, and about two thirds of this water is inside the cells, the rest being outside them. The amount of water outside the cells, including that of the blood, ordinarily changes little. Inside the cells the amount changes with the intake of fluids or the output of urine and sweat. When the water in the cells is reduced, thirst is felt. After a man drinks a large amount of alcohol, water moves from inside his cells to the spaces about them. This causes the feeling of thirst even though the whole body has not lost water. Whether this temporary shift in the distribution of body water has any other effect than causing thirst, is not known.

*The Heart and Circulation.*—A drink of whisky may make the heart beat faster and give a sensation of warmth to the skin. This is caused by the momentary irritation of the nerve endings in the mouth, throat and gullet by the strong alcohol solution. The faster heartbeat increases the blood flow. The blood vessels near the surface of the skin become dilated, and this produces the feeling of warmth there. Actually this causes a slight loss of heat from the body.

These short effects of a drink or two cause no lasting changes in the heart. There is no evidence that moderate amounts of alcohol cause heart disease, high blood pressure, or hardening of the arteries. Getting drunk does tax the heart and would be dangerous for a man with heart disease.

*Alcohol and Energy.*—At one time people thought that alcohol was especially helpful in doing hard work. They even supposed that heavy

laborers could not work well without it. Perhaps in olden times th
was true in an indirect way. Some men labored so hard and long ea
day that they might not have been able to bear the pain and fatig
without the sedation of alcohol. As their labor was not skilled, th
amounts they drank did not interfere noticeably with their efficien

When the belief that alcohol improved muscular work was cha
lenged, however, it was shown to be a fallacy. A farmhand, for e
ample, could work just as well, or even better, if not plied with liqu
during the day, provided he was well fed otherwise. Later, certa
laboratory experiments with muscle work were thought by some
mean that the body could not use alcohol as a food or fuel at all.

The fact is that as alcohol is used up (oxidized) in the body it
changed to various substances, one of which is acetate. This compou
is formed from the oxidation of many foods, and the body uses th
acetate from any source for its energy needs, for work or heat. Th
alcohol can be a source of energy for the work of muscles, and in th
sense at least, it is a food. But two important facts should be remem
bered in this connection:

First, the amount of alcohol that the body can burn is limited,
noted before, to about ½ ounce per hour. Thus only a limited amou
of the energy needed for work can be supplied by alcohol.

Second, though alcohol supplies calories, it does not provide certa
essential needs of the body which come in other foods—the vitamin
minerals and proteins, for instance, which come along with the calori
in bread, milk, meat, eggs, cereals, fruits and vegetables.

Anyone who relied on alcohol for any large part of his energy wou
end with some serious diseases. That, in fact, is what happens to man
excessive drinkers.

*Length of Life.*—One question that crops up in discussions of effec
of alcohol is whether drinking has an influence on how long one ma
live. There is no question that those who drink to excess over man
years have a shorter average life span than those who abstain or drin
moderately. But what about the moderate drinkers compared to ab
stainers? This question is not so easy to answer as might be supposed
The best source of information on length of life is insurance compan
records. But these records do not definitely point out who is a "moder
ate drinker." Scientists who have carefully reviewed all the studies o

this question are of the opinion that truly moderate drinkers are not different in length of life from abstainers.

*Other Effects.*—Research in many laboratories has shown a great variety of changes in the body with the drinking of different amounts of alcohol. For the most part, these changes take place only with large amounts. For example, the body puts out an excess of potassium in the urine after a large amount of alcohol is drunk. It is important to bear in mind that by no means all effects of alcohol on the body have been dealt with here. But what has been said about those which were described, applies generally. The changes are temporary. The body returns to its usual state soon after it has disposed of the alcohol. Some of the changes cause temporary impairment of the work of one or another organ. Some of these changes may be the body's way of defending itself from being hurt by the sudden presence of a large amount of alcohol.

As far as the over-all health of the body is concerned, none of these changes is important if not repeated often or allowed to go to an extreme degree. The main physical danger in drinking more than the body can oxidize within a short time is in becoming intoxicated, getting drunk. The body of the drunken man is always in danger, for its director, its brain, its safety guard, is working under a handicap—it is under an anesthetic.

## ALCOHOL AS MEDICINE

THUS far we have considered alcoholic beverages taken by healthy people for certain effects which they find agreeable, or because they want to go along with social customs. Some people, however, use these drinks as medicines for different ailments. Some believe a drink of one sort or another is good for their health—or even necessary for good health. Alcoholic beverages are prescribed by physicians for certain disorders, and some physicians inject alcohol directly into the blood stream of certain patients. What are the effects of these uses on the body? Do alcoholic beverages contribute directly to health?

The use of alcoholic beverages in the treatment of many disorders has a long history. No doubt they must have been of benefit to patients who were in pain and distress with all sorts of scarcely understood diseases. For alcohol acts on the brain as a sedative and thus suppresses the

sensation of pain. Men noticed that the sick "felt better" after taki some wine, for example, and so they assumed that the beverage h the quality of a medicine for the particular illness. Thus there grew a tradition of the medicinal properties of alcoholic beverages, and ev ideas of the special fitness of this or that wine for this or that disea

When distilling became popular in Europe, in the 16th centu brandy and other spirits gained attention as useful in medicine, and wonder. A strong distillate was much more efficient in relieving pa than a wine with only a fifth as much alcohol in it. At times alcoh was the only anesthetic for the performance of surgery. Soon spec kinds of distilled spirits were recommended for particular ailments. O example was gin for the kidneys, because gin seemed to promote uri nation. Actually, experiments have shown that ordinary alcohol h the same effect on the flow of urine as gin.

In more recent times the real causes of many illnesses came to b understood, and medications which act directly on the cause of th symptoms could be prepared. Thus, 50 years ago alcohol was pre scribed for diabetes—with little benefit. Nowadays the diabetic i treated successfully by control of diet and injections of insulin. Serum sulfa-drugs and anti-biotics replaced alcohol in the treatment of pneu monia. The prescription of alcohol thus declined sharply.

In popular usage, however, and especially for common ailments fo which there are as yet no specific medicines, the taking of alcohol per sists. Rum is taken for a cold. It does not cure a cold. It may, however relieve the aches and pains, as would other analgesic drugs. Whisky i still given for snakebite. It does not counteract the venom. But it ma relax the victim a bit and thus ease his pain and terror. Brandy is given to someone who has fainted. It does not work on the cause of the faint ing, but helps revive the victim by its irritant action in the mouth and throat. Smelling salts do the same thing and are safer than pouring liquid down the throat of an unconscious person. Wine is said to build blood. It may dampen the pain that goes with anemia, but the physi cian today has really effective treatment for that disorder.

There are certain conditions, however, for which physicians find alcohol a valuable drug, making use of its special properties. One action of alcohol is to dilate some blood vessels. A drink is therefore sometime prescribed for elderly patients suffering from hardening of the arteries Alcohol also acts as a sedative. For the old, therefore, a drink may be

prescribed as a means of getting several effects at once: dilating their blood vessels, relieving their aches, pains and feeling of chilliness, reducing their tenseness and irritability, and rousing their appetite.

Alcohol also provides calories. This quality is used to advantage by surgeons in the cases of patients who cannot be fed after an operation. The alcohol is injected slowly into a vein so that the patient receives at the same time a certain amount of nourishment and a sedative for his pain. This use of alcohol by physicians has nothing to do with the ordinary drinking of beverages by healthy people, but it illustrates the variety of effects that alcohol exerts on the human body.

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