



Temperance Department.

TEMPERANCE PHYSIOLOGY.

FOR USE IN SCHOOLS AND BANDS OF HOPE.

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CHAPTER II.—FERMENTATION.

What is fermentation? When moist animal or vegetable matters are exposed to warm air, certain changes which take place alter their nature; these changes are produced by a process called fermentation.

When sugar is turning to alcohol and carbonic acid, the latter escapes in little bubbles, giving the entire liquid the appearance of boiling. We call this process, and others much like it, fermentation, from a Latin word which means to boil.

There are several kinds of fermentation. In these lessons we shall learn about only two of them.

I. *Vinous Fermentation*—the change of sugar to alcohol.

II. *Acetous Fermentation*—the change of alcohol and other substances to vinegar.

VINOUS FERMENTATION.

BACTERIA AND YEAST.

If you should look at a drop of stagnant water under a strong microscope, you would be quite likely to find it full of small living things, so tiny that you could not see them at all with the naked eye; these minute animal and vegetable forms are alive, and often in rapid motion.

In the air, also, are many living forms, too small to be seen by the naked eye, called bacteria.

There are particles coming from them much smaller than the full-grown bacteria, which will become bacteria by growth. These are called spores, and are floating almost everywhere in the air, and, from their extreme smallness, can get into places where the bacteria might not be able to come.

They have been carefully studied with the help of the microscope, and we know that, instead, of the air, it is these bacteria or their spores in the air, which produce fermentation in certain liquids.

The juices of the grape, apple, and many other fruits, will, if placed under the right conditions, ferment by the action of these living forms.

In order to ferment some other liquids and thus obtain intoxicating drinks, yeast* must be added. In this way some people brew home-made beer—by steeping various roots, barks, and herbs in water, and adding yeast and sugar enough to cause fermentation. The alcohol that is formed by the change on the sugar, makes the beer a dangerous drink.

When a liquid is fermenting, the little bubbles of carbonic acid carry a froth to the top, which can be used as yeast to act on other liquids. At the bottom lie the "settlings," a half-solid mass, sometimes called the lees. Between the froth and the lees is a thin, intoxicating liquid, which people drink under different names, as wine, cider, beer, etc.

Dry sugar will not ferment, nor will alcohol be formed in liquids which have an excess of sugar. The united action of sugar, water, heat, and of the bacteria or spores in the air, or of yeast—each in the right proportion—are always required to produce alcohol.

ALCOHOL FROM GRAINS.

Starch forms a large part of rye, corn, barley, and other grains. If these are kept moist and warm—as when planted in the earth in spring or summer—their starch turns to sugar, when the grain, which is a seed, begins to grow. Chew a grain of sprouted corn or barley, and you will find it sweet.

Barley is kept moist with water until it sprouts, or throws out little roots. During this process, most of the starch that is in the barley changes to sugar. Heat is then ap-

* Yeast is really a plant, and it is the growth of the yeast plant which causes fermentation in these liquids.

plied, strong enough to dry out all the moisture of the barley and kill the young roots.

Grain thus treated is called malt, and from this malt, pale ales and beers are made.

Heating to a higher temperature, so as slightly to burn the sprouted grain, makes dark malt, from which porter and stout—dark colored drinks—are manufactured.

If the sugar thus formed in barley is dissolved out of the grain with water, and yeast is added, and the whole exposed to warm air, another change takes place,—the sugar which was once starch, becomes alcohol, and carbonic acid. By this process, a good food has been changed to a poison; for the barley has become an intoxicating drink—ale, beer, or porter.

ALCOHOL AND BREAD.

We must not conclude that fermentation is never a good thing. If it is stopped at just the right point, and the alcohol all driven off by heat, it improves some kinds of food.

Crushed grain, or flour, is a valuable food; but, in this form, is not pleasant to eat. Yeast added to warm, moistened flour causes fermentation. A little of the starch in the flour turns to sugar, and then to alcohol and carbonic acid gas. This gas, in a thin liquid, would pass off into the air. But it is imprisoned by the sticky dough, and puff it up with little cells in its efforts to escape, thus making the otherwise solid mass, light and spongy.

The very small quantity of alcohol which was formed, evaporates, and the gas escapes when the dough is placed in the strong heat of the oven, and a light, sweet loaf of bread is left, that is better food than the flour.

Alcohol turns to vapor with less heat than water. In bread baked enough to be food fit for the human stomach, there is no alcohol. It has been turned to vapor by the heat of the oven, and has passed off into the air.

People who are ignorant of the truths you are learning in these lessons, have supposed that because fermented dough makes good bread to eat, therefore fermented barley-juice must make good beer to drink. But you know the alcohol stays in the beer and not in the bread, and that simple fact makes the difference, in this case, between a food and a poison.

AMOUNT OF ALCOHOL IN FERMENTED LIQUORS.

In one hundred parts of the fermented juice of apples, or cider, there are from two to ten parts of alcohol. In one hundred parts of beer—the fermented juice of barley—there are from three to ten parts of alcohol.

In one hundred parts of the fermented juice of grapes and other kinds of fruits, or wines, there are some six to twenty-five parts of alcohol.

It is estimated (in 1880) that twenty-two and three-quarter million gallons of alcohol are consumed every year by the people of this country, in beer alone.

This makes nearly one-half gallon of pure alcohol used by every man, woman, and child of our 50,000,000—if all were foolish enough to drink it.

As very many people drink no beer at all, some of the beer-drinkers must get more than this one-half gallon of poison during each year. Further study will show you the consequences of the use of this great quantity of alcohol.

HEAT AND FERMENTED LIQUORS.

If you were to place fermented liquors of any kind in an open kettle over strong heat, their charm for the wine, cider, or beer-lover, would soon be gone. It is for the sake of the alcohol they contain, that people are fond of these drinks, and this passes away in the form of vapor from the boiling liquid; the liquid which is left, has an insipid taste and no one would care to drink it.

ALCOHOL IN NATURE.

It is a mistake to suppose that because grapes, apples, and barley, are healthful foods, that wine, cider, and beer, made from them, must also be healthful.

It is important to remember that fermentation entirely changes the character of the substance it works upon. Nature rots her various plant forms; but while the juice remains protected from the air by the skin or husk of the unbroken grain, plant, or fruit, its sugar will not ferment—therefore, alcohol is never found in them.

ACETOUS FERMENTATION

ALCOHOL AND VINEGAR.

All vegetable substances come from earth, air, and water, and return to them again.

Through the process of fermentation, vegetable liquids go back to earth, air, and water. After the alcohol is formed, if it remains in the vegetable juice, exposed to moderately warm air; the second kind, or acetous fermentation, takes place, changing the alcohol to a sharp acid called acetic acid, commonly known as vinegar.

When the cook has not baked the bread at just the right time—that is, has not stopped the fermentation before the alcohol began to turn to vinegar in the dough, we say, "the bread is sour." This acetic acid does not pass off in the heat of the oven as alcohol does, but leaves its sour taste in the bread.

Vinous fermentation, producing alcohol, cannot take place in jellies and preserves, because they contain an excess of sugar. When they begin to "work"—as they may, if kept in moderately warm air—acetic acid, or vinegar, is produced in them by acetous fermentation; the acid is not made from alcohol in this case, but is the result of other changes in the fruit juices. "Scalding" makes them sweet again, by driving off this acetic acid, which can escape from a thin liquid, but not from a dough.

This acid is as different from alcohol, as alcohol is from sugar. It is used for food. Vinegar is made in this way from hard cider and other fermented liquors, and will change in its turn, if left in the same conditions that produced it, and lose its acid taste; its water all evaporating, nothing will remain but a brown powder.

The earth, air, and water have claimed again the matter only loaned to make the fruit, plant, or grain.

REVIEW QUESTIONS.

1. What is fermentation?
2. Define vinous fermentation. What are bacteria?—spores?
3. What four things are needed to produce alcohol?
4. How is malt made? What liquors are made from it?
5. Define acetous fermentation. When does it take place?
6. What causes sour bread?—the "working" of jellies?
7. How may vinegar be changed to earth, air, and water?

(To be Continued.)

LITTLE MRS. FAY'S DOCTOR.

BY A. L. NOBLE.

Little Moll Fay and Tom Gates were firm friends. As Moll was two years older than Tom they might not have played so much together if the other children in the neighborhood had not been very rough and ill-mannered. Moll was very gentle though determined, and Tom was "old-fashioned," his mother said. They had few playthings, and so "made believe" a great deal when they were together. One day Moll's old wooden doll had a fearful attack, which she described in detail to Tom, the family doctor, as "something a little like the colic, but much more like the leprosy."

Tom said it was "regular worst kind of leprosy; for that was very prevalent." And he went on in a way very wise for him, but one that would have proved an older doctor fit for a lunatic asylum.

Moll received it all as wisdom, and, with a comical pucker of distress on her sweet face, she asked if the "leprosy was often chronic."

Tom said: "Very seldom, unless it runs into fits; but Maria Jane appears to me to look fitly. You had better send right away to Wilkins' 'pothecary-shop, Mrs. Fay, and buy three pints of whiskey or rum. I will mix Maria up some excellent bitters, and you must give a gill of them to the poor child every ten minutes, until the fitty look passes off; then she may not die before daylight. If you don't hurry about it we must give Maria up."

Tom talked through his nose in a peculiarly solemn way, but little Mrs. Fay replied very briskly:

"Oh! no, Tom—I mean Doctor Gates—I won't do any such a thing. I can't let Maria have any sort of fits that need bitters, and I don't employ any whiskey doctor for my family."

"Why, Maria's system requires bitters!" gasped the doctor, quite surprised.

"Then Maria's system shan't have it, for her ma don't approve of it. Do you think I can go hunting all around saloons very late

nights for Maria as poor Mrs. W. Tom looked so puzzled at the doctor's words from Moll that she began to cry. "Mother says that dreadful doctor told him he would feel better if he took a little brandy every day. He began, and he kept right on until he lost all his work and his pretty house. Now he beats his children, and they never have enough to eat—all because that doctor started him drinking. Mother says he could have got along without brandy; and even if nothing but that would have cured him, Tom, if he had been your father, would you not rather have lost him when he was good? Now he is a wicked, horrible man. No, Maria has got to have cinnamon-tea or castor-oil."

"Well, Mrs. Fay, now you speak of it, I have seen castor-oil well rubbed in cure awful cases of leprosy, and Maria doesn't look as fitly as she did a while ago," said the doctor.

But "Mrs. Fay" was not a very faithful nurse, for she coolly tumbled her poor daughter behind a waterpail and left her to her agonies while she told Tom about "pretty little Mary Wilcox."

"She never had a present last Christmas, Tom; no, and not one of them had anything fit to eat until mother found it out and gave them plenty for that time."

Tom heard it with a grave face, and, when she ended, said: "I mean to be a really and truly doctor some day, but I won't tell anybody to drink whiskey. You'd better pick up Maria and see if she is dead."

Maria was as much alive as she ever had been, so they proposed a new play.—*Youth's Temperance Banner.*

THE COMMERCIAL TRAVELLER.

We know a commercial traveller who was taken dangerously ill in Glasgow, when far away from his home. When the medical man saw him, he said—

"You must have some brandy."
"No," he answered; "I have studied the nature of brandy, and I will not take it." The medical man protested that it would save his life.

"I will not take it," replied the patient. The ladies in the hotel were told of this, and two of them went into his room and implored him, for the sake of his wife and family, to imbibe the brandy.

"No," he replied; "I believe that brandy is of no use as a medicine, and I will not take it."

The medical attendants then proposed to call in an eminent physician, and have his advice. To this the traveller at once assented, and expressed his readiness to pay the consultation fee.

The great man, white-haired and venerable, came to the bedside of the invalid and carefully examined him. In quiet tones he then said—

"You are in great pain. Yes, in great pain, my friend. They tell me you will not take brandy." You are quite right. You need no brandy. Nor was any stimulant given him. Quiet, rest, warmth, wholesome food, and some gentle medicine cured him of the pain and sickness, and he has done many a good day's work since. Had he taken the brandy everybody would have said that it, and it alone, had cured him. But he recovered without it.—*Rev. George W. McCree, in Union Signal.*

A FATHER ROBBING HIS DAUGHTER.—
"I never knew a liquor-seller's money to stay in his family a generation, however much the man may have made by his trade. I once knew a publican who had a large fortune, made through selling whiskey. He became a confirmed drunkard, and his fortune soon vanished, and he was glad to get an allowance of a pound a week from his friends. He had one daughter, an invalid, who, through the kindness of some friends, was living at the coast, and was supported by some Christian ladies. After it came to her father's knowledge that she received money from these ladies, his visits were very frequent. He would go over to her bedside, on pretence of speaking to her, and put his hand under her pillow where he knew the money was kept, and always succeeded in carrying her little store away with him. When drink gets the mastery over any one, it makes its slave regardless of doing any dishonorable and heartless act."—*English Paper.*