NEW-WORLD HEALTH SERIES

PRIMER OF SANITATION

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NEW-WORLD HEALTH SERIES

BOOK II

PRIMER OF SANITATION

BEING A SIMPLE TEXTBOOK ON DISEASE GERMS AND HOW TO FIGHT THEM

BY

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PREFACE

"WHAT you would have appear in the life of the people, that you must put into the schools," is the substance of the advice given by a German educator to his countrymen. The soundness of this advice has never been questioned, and the experience of the writer of this book has brought the conviction that in sanitary matters it can be applied with absolute literalness, — that our country can hope to shake off completely and permanently its burden of preventable disease only when the public schools give adequate instruction in the principles of preventive medicine and in the possibilities of public hygiene. The author has therefore followed with sympathy and very great interest the efforts that are being made to teach sanitation in the public schools, and has felt that the effectiveness of these efforts would be very greatly increased if they were supplemented by an elementary textbook in this field. With this in mind he has tried to write down in a simple manner, and in a form suitable for school use, the more important facts in regard to germ diseases and their prevention. The public side of the question has been given considerable space, because the relation of the government to the health of its citizens is an important and an intimate one, and because we seem destined to come into a realization of civic obligation largely through public sanitation.

To those who have given of their time to read the manuscript of this book, the author wishes to express his gratitude. They have corrected many errors in it, although they are, of course, in no sense accountable for any that may remain. They have also given many valuable suggestions as to method of presentation and subject-matter to be included, which have been taken advantage of in the final revision of the manuscript, as far as space would permit. The following, nearly

all of whom have read the entire manuscript, are among those to whom special thanks are due: Dr. H. A. Barbee, Dr. David P. Barrows (who first suggested the writing of this book), Miss Josephine K. Bauer, Dr. J. H. Billings, Dr. H. M. Bracken, Dr. Hiram Byrd, Professor J. S. Caldwell (joint-author of the Ritchie-Caldwell Series), Dr. E. C. Coleman, F. S. Crum, Dr. S. J. Crumbine, Commissioner E. G. Dexter, Dr. D. Harvey Dillon, Dr. F. B. Dresslar, Dr. William Ettinger, Professor Irving Fisher, E. Le B. Goodwin, Professor C. W. Hetherington, Frederick L. Hoffman, Dr. H. D. Holton, Dr. J. N. Hurty, President David Starr Jordan, Dr. J. M. King, Dr. James Lee, Dr. William F. Litterer, Dr. E. M. Mason, Miss Jessie B. Montgomery, Dr. William H. Park, Henry C. Pearson, Miss Mary D. Pierce, Dr. M. L. Price, Dr. C. O. Probst, Dr. E. P. Quain, Dr. C. A. Smith, Dr. Larkin Smith, Dr. William F. Snow, M. A. Spratt, Dr. C. W. Stiles, Miss Marion Talbot, Dr. H. H. Taylor, Dr. Louis A. Thomas, Dr. J. H. Townsend, Dr. T. D. Tuttle, Dr. W. L. Vercoe, Dr. Cressy L. Wilbur, Dr. E. G. Williams, Dr. R. C. Yenney.

To make sure that the health problems of every section of the United States were treated, the book was submitted in proof form to health officials and other medical authorities representing all the States. For the many hints and suggestions received from these sources, grateful acknowledgment is made, with regret that space does not permit personal mention of each reader.

With the hope that it may play some part in lessening the appalling economic and vital loss from preventable disease that is constantly sapping our nation's strength, this little book is sent forth.

PREFACE TO THE REVISED EDITION

THE cordial reception given to this small volume seemed to indicate that it fitted into an unoccupied niche in our schools, and its continued and extended use has led the author to hope that in some measure at least it is serving the purpose for which it was written. In order to keep the subject-matter in harmony with our rapidly advancing sanitary knowledge, various changes have been made from time to time in the plates, and at this time the entire text has been carefully revised. This plan of constant revision makes it inevitable that there shall be certain slight differences in different editions of the book, but the advantages of keeping our teaching of the subject up to date are so obvious that no one has counseled uniformity at the expense of progress. In the present edition, only necessary changes have been made in the body of the text, and two additional chapters containing important new matter have been placed at the end of the volume. By this arrangement, it is believed that the teacher will be able easily to harmonize any seeming discrepancies in different editions used in the same class, and that at the same time the class will have the advantage of becoming familiar with the newer sanitary ideas and discoveries.

For an authoritative reference book on sanitary topics, Rosenau's *Preventive Medicine and Hygiene* (Appleton and Company, New York) is without an equal. It is a large and very complete work, but it is easily read by even a layman in the subject. Jordan's *General Bacteriology* (W. B. Saunders Company, Philadelphia) is also very valuable to the student in this field.

CONTENTS

CHAPTER ONE

WHY THE STUDY OF DISEASE GERMS IS IMPORTANT

SUPPOSE that in a happy and healthful village a strange plant should suddenly spring up and give off poisonous matter into the air. Suppose that every one who passed by it became ill, and that all the people who lived near it died because of the deadly gases from the plant. Would the people of the village allow that plant to ripen its seeds and scatter them abroad so that in a short time plants of the same kind would be growing along all the streets and in all the dooryards? Or would the people cut down the plant and destroy it root and branch?

Suppose that poisonous serpents should appear in a town and should attack the people. Would the inhabitants of that town allow the serpents to live and multiply in the streets and about their houses? Or would they hunt out and kill the reptiles that were doing them so much injury?

The people would certainly destroy both the deadly plant and the poisonous serpents, for no one would wish to suffer illness or death because of them.

Poisonous plants like the one described above do not exist, and, in most parts of the world, dangerous serpents are very rare. But in all the earth there is not a town or a village where there are not great numbers of very small plants and animals that attack the people and cause many of them to become sick and die. These small plants and animals are called *disease germs*, and they cause many of the worst diseases that afflict mankind.

In a country where dangerous wild animals are found, the inhabitants know when they are safe and when they must be on their guard; they know that their enemies lurk only in certain places, and by avoiding these places they are usually able to live in security and peace. But a stranger in such a land often imagines that monsters are everywhere waiting for him; even when he is far from danger he is beset with constant fears; and in spite of all his care he is likely to walk straight into the midst of his foes.

So a person who understands about disease germs gives little thought to them, because he knows when he is safe and how and when to guard himself from them. But persons who do not understand about germs often foolishly imagine that the world is full of them; they live in constant fear and make many useless efforts to guard themselves from them; and then in some simple manner they allow the germs to get to them.

In this book we shall study about disease germs and how to avoid them. It is important for you to understand this subject; for a knowledge of it will often enable you to protect yourself from germs; it will allow your mind to be at peace when there is no danger from them; and it will help you to do your part in hastening the time when there will be no more disease germs in our land.

POINTS TO BE REMEMBERED

1. Everywhere very small plants and animals called disease germs are attacking people and causing sickness.
2. It is important for you to understand about disease germs in order to know how to escape them and avoid being frightened when there is no danger from them.

CHAPTER TWO

THE CELLS OF THE BODY

As a house is built of bricks and a heap of sand is composed of a multitude of small grains, so is the human body made up of a great number of very small parts called *cells*. These cells are so small that we cannot

FIG. 1. When we look at a house from a distance we cannot see the bricks in the walls.

FIG. 2. But when we stand close to the house, we can easily see the bricks of which it is built.

see them without a microscope, but if you could examine a small piece of skin or other part of the body under a microscope, you could very easily see the cells of which it is composed. The skin, the muscles, the liver, the stomach, the brain, and all the other body parts are built of these little cells.[1]

The cells are alive. Each one of the little cells of the body is alive. Each one takes in food and grows, and does all those things that make a living being different from sticks and stones and other things that are not

[1] The cells of the body are exceedingly small. So small are they that it would take about 2500 of them placed side by side to make a row an inch long. There are 5,000,000 cells in a very small drop of blood, and according to one estimate, 400,000,000,000 cells in the average human body.

alive. When the cells are in health, the body is in health; and when the cells are dead, the body is dead; for the life of the body is in the cells of which it is built.

FIG. 3. When we look at the body, we cannot see the cells of which it is made. But with a microscope the cells of the body are easily seen.

Keeping our bodies in health. Certain things are necessary to the cells of the body. They must have food, they must have oxygen from the air, they must get rid of their poisonous wastes, and they must have a constant temperature, neither too hot nor too cold. If our cells do not have all these things, they will die. They may be killed in other ways, too, as by being crushed, by electricity, and by poisons. To keep our bodies in health, therefore, we must supply our cells with the things that they need and we must keep poisons and other injurious substances away from them.

Disease germs. Our bodies are very wonderful machines, but sooner or later sickness comes to most of us. Sometimes the stomach and other digestive organs fail to work properly, and then the cells suffer from a

lack of food. Sometimes the heart and blood vessels become diseased, and then the blood fails to circulate through the body as it should. Sometimes the kidneys fail in their work, and then the cells are injured by poisonous wastes. But the most common of all causes

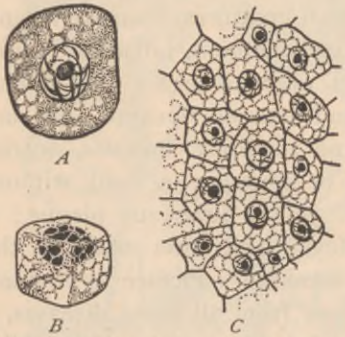


FIG. 4. *A* is a single cell as it appears under the microscope. *B* is a cell drawn to show that it has length, breadth, and thickness. *C* is a group of cells, showing how they are built together in the body.

FIG. 5. A section of the outer layer of the skin, as it appears under a microscope. The outer cells die and fall off as dry scales.

of sickness is that disease germs get into the body and poison the cells. In the next chapter we shall learn more about these small germs and how they cause disease.

POINTS TO BE REMEMBERED

1. The human body is built of very small cells.
2. The cells are alive.
3. When the cells are in health, the body is in health, and when all the cells are dead, the body is dead.
4. The cells must have food and oxygen, and they must not be poisoned or injured in other ways, or they will die.
5. Disease germs cause sickness by poisoning the cells.

CHAPTER THREE

DISEASE GERMS AND HOW THEY GET INTO THE BODY

DISEASE germs are the greatest enemies of mankind. Every day they kill thousands of people, and they cause the loss of an untold amount of time and money. To get an idea of the amount of sickness, sorrow, and loss that is caused by these small creatures, imagine a land where no colds, catarrh, consumption, influenza (grip), diphtheria, or pneumonia ever come; a land where boils, blood poisoning, and tetanus (lockjaw) are unknown; where there is no smallpox, measles, scarlet fever, whooping cough, or mumps; a land without malaria, cholera, leprosy, yellow fever, or plague; a land free from typhoid fever, and from many of the other diseases that afflict mankind. Picture to yourself a country and a people free from all these diseases, a country where many of the inhabitants pass from childhood to old age without sickness or disease, and you will have an idea of what a land without disease germs would be like.[1]

What disease germs are. In water and in the soil there are millions of little plants and animals — plants and animals so small that they can be seen only with a powerful microscope. The body of one of these little plants or animals is composed of a single cell. The little one-celled plants are called *bacteria* (singular, *bacterium*). The little one-celled animals are called *protozoa* (singular, *protozoön*). *Disease germs are bacteria and protozoa that grow in the body and poison the cells.*

[1] It is within the power of man to cause all parasitic diseases to disappear from the world. — PASTEUR.

Where disease germs come from. At this point you should get it firmly fixed in your mind that disease germs are living plants and animals; and that just as a pine tree can come only from the seed of a pine

FIG. 6. The great outdoor world is practically free from germs.

tree, or as a chicken can come only from the egg of a chicken, so a disease germ can come only from another germ of the same kind. It is a common idea that germs spring from unclean and decaying matter —

that "filth breeds disease germs" — but this idea is not correct. They are often found in unclean matter, and such matter is dangerous because germs may remain alive in it for a long time. But germs can no more originate in such matter than a cow can come from the grass in the pasture, or a stalk of corn can spring up where no grain of corn has been planted in the earth. *Nearly all the germs that attack us are spread from the bodies of persons who are sick with germ diseases.*

The world not swarming with disease germs. From the very beginning of your study of this subject you should clearly understand that the world is not filled with disease germs that are lying in wait to attack us. It is true that bacteria and protozoa are abundant in water, that bacteria are swarming in the soil, and that they are constantly being blown about in the air. But of all the many hundreds of kinds of bacteria and protozoa that are in the world, only a few cause disease. The others are harmless, and even when they get into our bodies, it is not we, but the bacteria and protozoa, that suffer. The germs of most diseases quickly die outside the human body. It is a mistake to think that every breath of air is dangerous, and that all food and water contain disease germs. The winds that blow over the meadows, the rain that falls from the clouds, the trees of the forest, the grass in the pasture, and, in general, the great outdoor world, are practically free from germs. In the bodies of persons who are sick from germ diseases, in the houses where sick people live, and wherever the wastes from the bodies of the sick go, there, and

in most cases there only, are disease germs to be found.

The first great rule for the prevention of germ diseases. The first great rule for the prevention of germ diseases is: *destroy the germs that come from the bodies of the sick.* If all the diphtheria germs that come from human throats could be destroyed, there would soon be no more diphtheria. If all smallpox germs that come from the bodies of persons who have the disease could be destroyed, there would soon be no more smallpox. It is easier to destroy germs as they come from the bodies of the sick than it is to destroy them after they have been spread abroad, and a little intelligent care used in keeping germs from being scattered would every year save millions of lives.

FIG. 7. The germs that attack us come from the bodies of the sick.

How germs enter the body. Except in a few cases which we shall discuss later, germs do not pass through the unbroken skin, but *nearly all germs that enter the body get into it through wounds, or through the mouth or nose.* In later chapters we shall learn what germs get into the body through cuts and sores; we shall study about biting insects (mosquitoes, flies, ticks, fleas, and bedbugs) that pierce our germ-proof armor (the skin) and place germs directly in the wounds that they make. We shall read of other germs that enter the body by

way of the nose, and we shall learn how very dangerous germs may reach the mouth from flies, from the hands, from drinking cups, in food and water, and in many other ways. Here we wish only to call your attention to the fact that wounds (many of them made by insects), the nose, and the mouth are the gateways through which disease germs get into the body.

The second great rule for the prevention of germ diseases. The second rule for the prevention of germ diseases is: *take care of wounds, protect yourself from biting insects, and guard the mouth and nose.* The first rule aims to keep disease germs from being scattered abroad. The second rule aims to keep out of the body the germs that do get scattered abroad. If we neglect either of these laws, we cannot hope to escape the diseases that are caused by germs.

POINTS TO BE REMEMBERED

1. Disease germs kill more than half the human race.
2. Disease germs are very small plants and animals.
3. A disease germ can spring only from another germ of the same kind.
4. Nearly all the germs that attack us come from the bodies of sick persons.
5. The first great rule for the prevention of germ diseases is: *destroy the germs that come from the bodies of the sick.*
6. Germs enter the body through wounds, through the nose, and through the mouth.
7. The second great rule for the prevention of germ diseases is: *take care of wounds, protect yourself from biting insects, and guard the mouth and nose.*

CHAPTER FOUR

THE STRUGGLE BETWEEN THE BODY AND THE GERMS

In spite of the greatest care that we can take, all of us are certain at times to get the germs of very dangerous diseases into our bodies. Indeed, on the skin and in the throats of most persons, germs that can cause disease may at all times be found (pages 24, 43). Between these germs and the body there is never-ceasing war. The germs attack the body. They try to grow in it and use it for food. To defend itself the body kills the germs. Day by day and year by year the struggle goes on, the germs attacking, the body fighting to keep out the germs. In this chapter we shall learn how the body resists its small foes.

How germs cause sickness. When disease germs grow in the body, they produce poisons that are called *toxins*. These toxins are carried through the body in the blood, and cause sickness by poisoning the cells. A little group of tetanus (lockjaw) germs in a small wound, or a small patch of diphtheria germs growing in the throat, may produce enough toxin to poison and kill the whole body. Try to fix clearly in your mind that *it is not the germs themselves, but the toxins (poisons) that the germs produce, that cause the sickness.*

FIG. 8. *A* shows the white and *B* the red corpuscles of the blood as they appear under a microscope.

How the body destroys toxins. One way in which the body protects itself against germs is by producing *antitoxins*. When disease germs grow in the body and

begin to poison it with toxin, the body begins to produce antitoxin. *The antitoxin does not kill the germs, but it does destroy the toxin,* and thus saves the cells from being poisoned until in other ways the body can kill out the germs.[1]

How the body kills germs. If you should examine a drop of blood with a microscope, you would find a very great number of cells floating in the liquid part of the

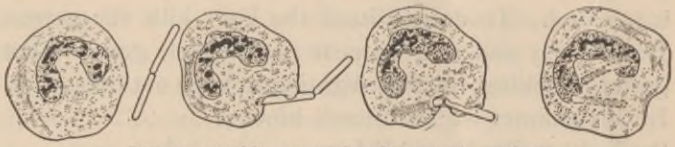


FIG. 9. A white corpuscle taking in a bacterium.

blood (Fig. 8). These cells are of two kinds. Most of them are red in color, and these are called *red corpuscles.* Their work is to carry oxygen through the body. The other kind of cells in the blood are the *white corpuscles.* These are the soldiers of the body, and *their work is to kill disease germs.*

A white corpuscle approaches a germ and flows about it, or swallows it, as you see in Figure 9. Then the corpuscle tries to digest and kill the germ, while the germ tries to grow in the corpuscle and use it for food. When the corpuscles are victorious, the germs are destroyed and the disease is stopped. But if the germs are too numerous and too powerful, the corpuscles are killed, and the disease goes on until the body dies.

[1] There is a different toxin and antitoxin in each different germ disease. The toxin and antitoxin of diphtheria, for example, are different from the toxin and antitoxin of tetanus or of typhoid fever.

Besides the white corpuscles, there is another great defender of the body, the *germicidal* ("germ-killing") substance of the blood. There is always some of this substance in the blood of a healthy person, and when disease germs attack the body, more of the germicidal substance appears in the blood and helps to kill them. In our fight against the germs this germicidal substance is perhaps even more important than the white corpuscles.[1]

Why we have certain diseases only once. When germs attack us, the body manufactures more of its germicidal substances to kill them. More and more of the germicidal substance is formed, and the blood becomes stronger and stronger in its power to kill germs. Finally, if the body is successful in its struggle with its enemies, the germicidal substance and the white corpuscles get the upper hand of the germs and recovery begins. After a patient recovers from some diseases (for example, smallpox, measles, and whooping cough), a large amount of germicidal substance remains in the blood for years, or even for life. Any germs of these diseases that get into the blood are therefore promptly killed, and a person is seldom attacked by one of these diseases more than once. After other diseases (for example, pneumonia, influenza, and colds), the increased power of the body to kill the germs quickly disappears, and we may have these diseases again and again.

[1] The body produces different germicidal substances in killing the germs of different diseases, just as different toxins and antitoxins are produced in different diseases. A person therefore may have a great power of killing the germs of one disease, as, for example, smallpox, and at the same time fall an easy victim to some other disease, as consumption.

Keeping up the resistance of the body to germs. Through all your study of germ diseases you should bear in mind the importance of keeping up the germicidal power of the body. All of us, without knowing it,

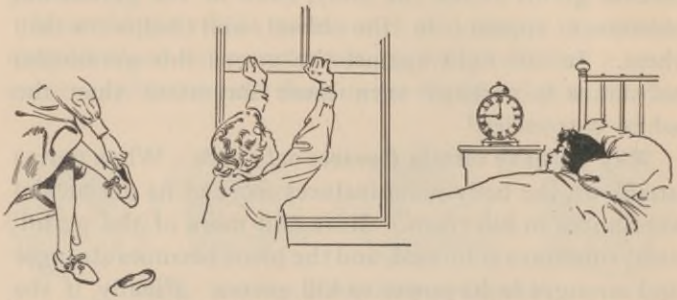


FIG. 10. Dry feet, fresh air, and plenty of sleep help to keep up the power of the body to kill germs.

take into our bodies the germs of deadly diseases. As the seeds of plants lie in the cold earth waiting for the warmth of spring to come, so these germs often lie in the body waiting for a chance to grow. The only safe way, therefore, is to keep the body always in health, so that it will be able to kill any disease germs that may enter it. Overwork, exposure to cold, wet feet, hunger, fatigue, worry, lack of fresh air, lack of sleep, alcohol — all of these things injure the body and lower its germicidal power. It is the duty of every one to keep himself in health — to care for his body intelligently and carefully — and to fail to do this is no more sensible than it would be sensible for the soldiers in a fort to open the gates and lie down to sleep in the midst of their enemies.

Alcohol and resistance to germs. Experiments on animals prove that alcohol lessens the power of the body

to kill germs. When alcohol is given to rabbits it is not possible to save them from rabies (hydrophobia) by the Pasteur treatment (page 129). Other experiments show that the germs which cause boils and blood poisoning are able to attack rabbits that have had alcohol more easily than they can attack rabbits that have had no alcohol. Still other experiments show that animals which have been given alcohol cannot resist the germs of cholera, tetanus (lockjaw), and other diseases so well as animals which have not been given alcohol. Experiments like these leave no room to doubt that alcohol taken into the body lessens the power of the blood to kill germs.

Many physicians have long believed that this was true, for they have known that drinkers suffer far more from many germ diseases than do those who use no alcohol. A spell of drinking often brings on an attack of pneumonia, and the death rate from pneumonia is very high among drinkers. Consumption is also very common among drinkers, the records of one German life insurance company showing a consumption death rate more than five times as high among brewers as among Protestant ministers. Wounds heal less rapidly in users of alcohol than in abstainers, and the inflammation is more likely to run on into blood poisoning in a drinker. So in cholera and typhoid fever it is the drinkers who suffer most, and there is every reason to believe that this is the case in all germ diseases. Drink no alcohol if you wish to keep up the power of your body to resist germs, for users of alcohol are attacked by germ diseases more frequently than abstainers, and many of them die of these diseases when they are attacked.

The third great rule for the prevention of germ diseases. The third great rule for the prevention of germ diseases is: *keep the body in health, so that it will be able to kill disease germs.* A general does not risk the fate of his army on a single battle line, but behind the first line of soldiers he places a second line, and behind the second line he has still a third line of defense in case the enemy

FIG. 11. The Castle of Health. Read the three rules for the prevention of germ diseases, and tell what the two outer defenses of the castle, and the walls of the castle itself, represent.

should break through the first and second lines. So in our warfare with the germs we should not depend on any single line of defense. We should try to keep germs from being spread about, we should guard the gateways by which they enter the body, and within the body we should have the defenders at their posts. For sooner or later, just when we cannot tell, our unsleeping enemies will pass through the first and second lines of our defense, and if at that time the health of the body is low and the defenders of the body are weak, it will be the worse for us.

Increasing the defenses of the body by vaccination. Vaccination has been employed as a protection against

smallpox for more than a century (page 119) and of recent years it has been used to increase the resistance of the body to the germs of rabies, boils, typhoid fever, plague, and of many other diseases. In vaccination, weak or dead germs of the kind that cause the disease are introduced into the body. This causes the body to manufacture germicidal substances, or it increases the activity of the white corpuscles, thus providing a defense against the living germs that cause the disease. In later chapters we shall discuss this subject in more detail.

POINTS TO BE REMEMBERED

1. Dangerous germs often get into the body in spite of the greatest care that we can take.
2. These germs cause disease by producing toxins which poison the body.
3. The body defends itself by producing antitoxins that destroy the toxins.
4. The body kills germs by means of the white corpuscles and the germicidal substances of the blood.
5. We have certain diseases only once because after recovery from these diseases the germicidal substances remain strong in the blood.
6. The germicidal power of the body should not be allowed to run low, because disease germs may be in the body waiting for a chance to grow, or may get into it at times unknown to us.
7. Alcohol lessens the power of the body to kill germs.
8. The third great rule for the prevention of germ diseases is: *keep the body in health, so that it will be able to kill disease germs.*
9. The resistance of the body to certain germs may be increased by vaccination.

CHAPTER FIVE

BACTERIA

BACTERIA are the smallest of all living things. Millions of them have plenty of room to swim in a drop of water. Twenty-five thousand of them placed side by side would make a row only an inch long. Examined under a microscope that would cause a man to appear as high as Mt. Washington or Mt. Mitchell, these small plants look about as large as periods and commas in ordinary print. So exceedingly small are they that they can pass through the pores of a brick as easily as a man can pass through the doorway of a house.

The multiplication of bacteria. Bacteria multiply by simply pinching in two. Some of them can divide and

FIG. 12. A diagram showing the way a bacterium multiplies by pinching in two.

FIG. 13. The three shapes of bacteria, — cocci, bacilli, and spirilla.

become full-grown in fifteen or twenty minutes; but this, of course, is very rapid, even for a bacterium. They can easily divide once an hour, however, and at this rate one bacterium even in a single day can increase to a multitude. It is this power of rapid multiplication that makes disease germs dangerous to mankind.

The shapes of bacteria. Bacteria are cylindrical, spherical, or spiral — shaped like a fire-cracker, a marble, or a corkscrew. The cylindrical bacteria are called *bacilli* (singular, *bacillus*). The spherical bacteria are called

cocci (singular, *coccus*), and the spiral forms are called *spirilla* (singular, *spirillum*). The shapes of bacteria have nothing to do with the diseases which they cause, but often give a convenient way of distinguishing between different kinds.

Where bacteria are found in nature. Bacteria are blown about in the air, clinging to particles of dust. They abound in the upper layers of the soil, but in ordinary soils do not live deeper than six feet below the surface. They are very abundant in the waters of streams, ponds, lakes, springs, and shallow wells, a quart of ordinary well water having in it something like a million of them. They are always found in great numbers about the bodies of men and animals, flourishing especially in the mouth, nose, throat, and intestine, and on the skin.

Dangerous, harmless, and useful bacteria. Some kinds of bacteria cause disease, and a few kinds are useful to man. Most of them, however, lead their little lives in the soil, in water, or even in our own bodies, and neither help nor harm us. Among useful bacteria are those that take a part in butter and cheese making, and those that help to increase the fertility of the land. The bacteria of decay, although they destroy much of our food, are also, on the whole, useful to us. Imagine what the world would be like if all the animals and plants that have lived and died in it were lying about us, and you will be convinced that the bacteria of decay are our friends and not our enemies.

The spores of bacteria. Certain kinds of bacteria produce *spores* when hard times come upon them. A spore is formed by the living matter of a bacterium

gathering itself into a little, hard ball that rests, like a little seed, until food, moisture, and other good conditions for growth return. Then it grows again into an ordinary bacterium, which goes on growing and multiplying as before. So very difficult are bacterial spores to kill, that some of them have been found alive after they had been dried for ten years, and others are not killed by boiling them for several hours. Fortunately for us, the germs of none of our most common diseases produce spores, and these germs may be killed by a very moderate amount of heat (page 158).

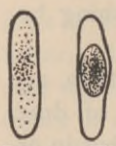


FIG. 14. The right-hand figure shows a spore of a bacterium.

POINTS TO BE REMEMBERED

1. Bacteria are the smallest of all living things.
2. They multiply with astonishing rapidity by simply pinching in two.
3. A bacterium is called a bacillus, a coccus, or a spirillum, according to its shape.
4. Some bacteria are useful, and many of them are harmless, but a few kinds produce disease.
5. Some bacteria produce spores that are much harder to kill than are the bacteria themselves.

CHAPTER SIX

THE SKIN

WITHOUT the skin to protect us, it is probable that bacteria would swarm into our bodies in such numbers that in a week there would not be a living human being in the world. We know that this is true, because most of the bacteria that attack us enter the body by way of two small openings (the mouth and the nose), and because when even a single cut or tear is made in the skin, the body is sometimes hardly able to hold back the germs. If the inhabitants of a besieged city were hard pressed to defend a single open gate of the city, we should not think that they stood much chance of holding back the enemy if the whole city wall were thrown down. So if the body is hardly able to defend itself when there is only one wound in the skin, we should not expect it to keep up the fight long if the covering behind which it is sheltered were removed.

FIG. 15. A section of the skin.

The structure of the skin. The skin is composed of an inner layer called the *dermis*, and an outer layer called the *epidermis*. The hairs stand in deep narrow pockets that are called *hair follicles*. Through the epidermis, the

sweat glands open on the surface of the skin by little pores or openings.

Bacteria that enter the body through the skin. The weak places in our armor of skin are the hair follicles and sweat glands. Through these weak points certain

FIGS. 16 and 17. If bacteria were large enough for us to see them without a microscope, a pencil that had been in some one's mouth would appear something like this, and the legs of a fly would be seen to be loaded with germs.

bacteria do sometimes work down and cause inflammation, pimples, boils, carbuncles, and erysipelas. These same bacteria also enter the body through wounds, and a considerable number of other disease-producing bacteria get into the body either through wounds or by the bites of insects.

Bacteria real living plants. In the next chapter we shall discuss the bacteria that enter the body through the skin. During your study of this chapter, as well as during your study of later chapters, it will help you greatly if you can get a clear picture in your mind of what bacteria are really like. Remember that the moss which clings to the bark of a tree is on the tree, even though you cannot see it from a distance. So if you could only see them with your unaided eyes, there are, as it were, great forests of bacteria growing on your

skin, and clusters of bacteria hanging to particles of dirt and to the legs of flies. Whether we see them or not, bacteria are real living plants, and you should be able to call up pictures of these little plants in your mind.

You can help yourself to get clear and correct ideas in regard to bacteria by asking your teacher about the points that you do not understand, and you can learn much about them from a physician. For physicians know many things about bacteria that are not found in a little book of this kind; they can tell you many things that a teacher cannot be expected to know; and sometimes they allow boys and girls to look at bacteria through their microscopes.

POINTS TO BE REMEMBERED

1. The work of the skin in protecting us from germs is very important.
2. The skin has two layers, the dermis and the epidermis.
3. The hairs stand in small pockets in the skin that are called hair follicles.
4. The sweat glands lie in the dermis and open on the surface of the skin from below.
5. Certain disease-producing bacteria enter the body through the hair follicles and sweat glands, through wounds, or from the bites of insects.

CHAPTER SEVEN

THE PUS-FORMING BACTERIA

THE pus-forming germs are among the most widespread of all the germs that are capable of causing disease. They are found in the soil around the dwellings of men and of animals, they are common in unclean water, and they always occur in great numbers on the human skin, where they feed on the dead cells and other matter on the skin. There are several different kinds of these bacteria, but they all cause inflammation and form pus, the thick, creamy, liquid matter that is found in boils and infected wounds.

Diseases caused by pus-forming bacteria. The pus-forming bacteria may grow in almost any part of the body and cause inflammation of the part that is attacked. In wounds they cause pus to be formed. In the skin they cause pimples, boils, carbuncles, and erysipelas. Very commonly they attack the walls of the throat or intestine and cause tonsillitis, sore throat, inflammation of the bowels, or appendicitis. Occasionally they attack the membranes around the brain and cause meningitis, or set up their growth in the lungs and cause pneumonia. In like manner they may grow in the lining of the heart, or they may spread through all the body and cause blood poisoning.

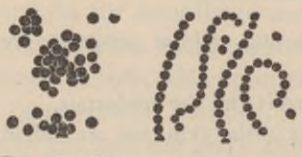


FIG. 18. The two most common pus-forming germs.

The different kinds of pus-forming bacteria. The most common of the pus-forming bacteria is a small coccus (*Staphylococcus*[1]) that grows in bunches or clusters

[1] Pronounced stăf-il-ō-kŏk′-kŭs.

(Fig. 18). This coccus is the usual cause of pus in small wounds, of pimples, boils, and carbuncles, and of inflammation and ulcers in the bones. It may also cause blood poisoning, and is sometimes found in other cases of inflammation.

Another common pus-forming bacterium is a coccus (*Streptococcus*[1]) that grows in chains (Fig. 18). This germ causes erysipelas by making a widespreading growth in the skin. It is sometimes found in small sores and boils, but it more commonly attacks the inner parts of the body. It is often the cause of tonsillitis, appendicitis, and blood poisoning. More commonly than any other germ it is found in inflammation of the middle ear,[2] and it causes meningitis and pneumonia more frequently than do the other pus-forming bacteria. It is the most dangerous of all the pus-forming germs.

FIG. 19. A pus-forming bacillus.

A third pus-forming bacterium is a slender bacillus (*Bacillus pyocyaneus*[3]) that sometimes gets into wounds and causes bluish green pus to be formed. It is not so common in the body, nor is it so dangerous, as are the other kinds of pus-forming germs.

Weak and strong races of pus-forming bacteria. Some varieties of the pus-forming germs seem to be entirely harmless. Others are exceedingly dangerous, and whenever they have the opportunity produce the most violent

[1] Pronounced strĕp-tō-kŏk′-kŭs.

[2] The running ears that are common among children should receive prompt medical attention, both because there is danger of injury to the hearing, and because there is danger that germs will work their way through from the ear to the brain and cause meningitis.

[3] Pronounced pī-ō-sī-ā′-nē-ŭs.

cases of inflammation and blood poisoning. None of them should be allowed to enter the body when it can be prevented; but germs from a carbuncle, an old abscess, a case of erysipelas, or a case of blood poisoning are far more to be feared than germs of the same race from the skin or from some other source outside the body. It is a common thing for a person with a boil to scratch the germs into the skin with his fingernails, and cause a whole crop of boils in different parts of the body.

Care of wounds. For our protection against pus-forming germs it is very important to know how to care for small wounds. If the wound has been made by a clean instrument and bleeds freely, the blood will wash the germs outward, and by its germicidal power will probably kill any bacteria remaining in the wound. In such a case, the best thing to do is to tie up the wound "in the blood," and not open it until it is healed, unless inflammation sets in. A good plan is to wrap the wounded part in a thin, clean, inner cloth, and outside of this tie a second cloth. The outer cloth can be changed from time to time when it becomes soiled, while the inner cloth is left undisturbed to keep germs from getting into the wound. Wounds on the feet and hands, where dust and earth are likely to get into them, should have especially careful attention.

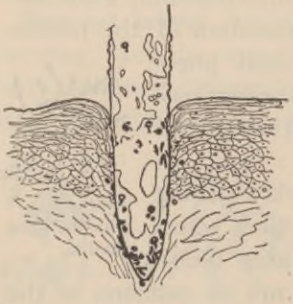


FIG. 20. If a nail or other instrument is driven through the skin, it will carry germs down and leave them among the cells.

A wound that has been made with anything unclean should be carefully washed in pure water, and where particles of earth or other matter have lodged in the wound, it is often advisable to use a clean cloth and pure soap in removing them. Where there is dirt in a wound, the wound should be washed with a disinfectant, as a five per cent solution of iodine in alcohol or ether. It is not best, however, to wash a wound with an irritating disinfectant, for these disinfectants injure the cells in the wound and weaken their resistance to the germs. Turpentine is an excellent agent with which to treat a wound, and one that is often at hand.

FIG. 21. Disease germs may be clinging to particles of dust that get into a wound. Therefore all dirt should be washed out of wounds.

After a wound has been bandaged, it should be carefully watched, and if pain, redness, or swelling shows that germs are growing in it, the wound should be opened and disinfected. A salve, such as borated vaseline, that contains boric acid, is often very useful in treating small infected wounds, and peroxid of hydrogen is used to flush out larger wounds and boils and to kill the germs in them. Peroxid of hydrogen must be used with care, however, or the tissues will be injured by it.

The pus-forming bacteria injurious to the body. It is a common belief that boils, pimples, and wounds that refuse to heal are signs of "impure blood," and it is sometimes thought that boils are beneficial to the body. Both these ideas are incorrect. When pus-forming bacteria are able to set up their growth in the body,

it means that the blood is weak in its power to kill these germs, and not that there is any impurity in the blood; and it no more benefits the body to have pus-forming bacteria kill groups of the cells and poison the whole system with their toxins than it would benefit it to be attacked by the germs of typhoid fever, pneumonia, or diphtheria.

Vaccination against pus-forming bacteria. Vaccination with dead germs is now a common treatment for boils and for any long-continued infection with either of the more common pus-forming bacteria. A serum prepared from the blood of the horse is also used in severe infections of one of these germs (streptococcus). This serum is similar to diphtheria antitoxin (page 39), but it is prepared by repeatedly vaccinating the horse with dead germs and instead of an antitoxin, it contains a substance for increasing the activity of the white corpuscles.

POINTS TO BE REMEMBERED

1. The pus-forming bacteria may grow in almost any part of the body.
2. These bacteria cause inflammation, pus formation, pimples, boils, carbuncles, erysipelas, tonsillitis, appendicitis, blood poisoning, and many other diseases.
3. There are weak and strong races of pus-forming bacteria, and the strong races are greatly to be feared.
4. Wounds should be cared for, to keep germs from growing in them.
5. The growth of pus-forming bacteria in the body is a sign that the body is weak and that the health needs attention.
6. The resistance of the body to pus-forming bacteria may be raised by vaccination.

CHAPTER EIGHT

TETANUS (LOCKJAW)

TETANUS is not a very common disease, but it is a most severe one. It affects chiefly man and the horse, but other animals may suffer from it. The incubation period (the time from the entrance of the germ into the body to the appearance of the disease) is usually from four to fourteen days.

FIG. 22. Germs of tetanus. Most of them have formed spores.

The germ of tetanus. The germ of tetanus is a rather long bacillus. It forms spores that are very difficult to kill (page 20). The natural home of the tetanus bacillus is in the soil, but it is swallowed by grass-eating animals, such as the cow, sheep, and horse, and not uncommonly grows in the intestines of these animals (especially in the intestine of the horse) without causing disease. It is therefore very common about stables.

So abundant are tetanus germs in certain kinds of soil that a handful of earth from a barnyard is almost certain to contain them, and the savage tribes of the New Hebrides Islands poison their arrows with tetanus germs by smearing them with earth from crab holes in swamps. A peculiar thing about the tetanus bacillus is that, unless other bacteria are present, *it cannot grow except when shut away from the air.* Along with other germs, however, it sometimes grows in an open wound.

How the tetanus germ enters the body. The tetanus germ enters the body through wounds, sometimes through wounds so small that they are not noticed. It is most frequently found in wounds made by unclean

instruments, because such wounds are most likely to get tetanus germs into them, and because dirt and other bacteria are left in wounds of this kind. It grows best of all in small, deep wounds, like those made by an unclean nail, because such wounds readily close over and

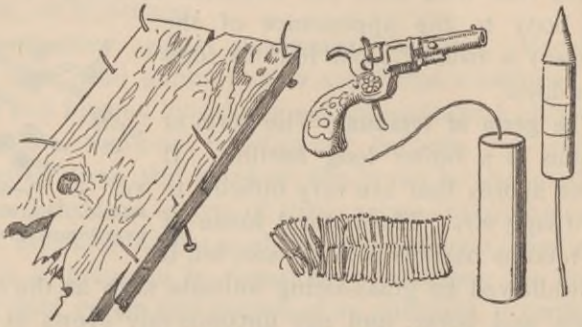


FIG. 23. Wounds made by these are often infected with tetanus germs.

leave the tetanus germ, with other germs and dirt, buried deep in the flesh. The percussion caps used on toy pistols, blank cartridges, and firecrackers also make dangerous wounds. The tetanus spores are in dust on the skin, and the small, sharp, flying particles of the cap, the wads of the blank cartridge, or pieces of the firecracker cut deep into the flesh and drive down these spores along with other bacteria and dust.

The importance of disinfecting wounds. The bacillus of tetanus is so common that undoubtedly it often gets into wounds in which it never grows. Its home, indeed, is in the earth, and it grows in the human body only when it finds conditions favorable. The disease is so dangerous, however, that it is always wise to look after and protect every wound, especially since the same measures

that cleanse a wound of tetanus germs will also free it from pus-forming bacteria. Wounds made by unclean instruments should therefore be carefully disinfected. Wounds on the feet of barefooted children also should receive careful attention, since these will come in contact with the earth and probably will get tetanus germs into them. It is best to have a physician look after a wound that is especially likely to furnish a favorable place for the growth of tetanus germs; for usually the disease develops suddenly and without any symptoms, often days after the wound is supposed to be healed.[1]

The toxin of tetanus. The tetanus germ makes only a very little growth in the body, but it produces a toxin of tremendous power. This toxin for man is a poison twenty times as strong as dried cobra venom, and almost three hundred times as strong as strychnin. It poisons the nervous system and causes all the muscles to be thrown into contraction. One of the first symptoms of tetanus is a stiffness of the muscles of the jaw and neck.

Tetanus antitoxin. An antitoxin for tetanus is prepared from the blood of the horse, but it has not proved very valuable in curing the disease, except when used in the early stages and in large doses. It is very valuable, however, in preventing the disease, and when a person has received a wound that is likely to bring on tetanus, a dose of the antitoxin should be given. When this is done, the disease is almost certain to be prevented.[2]

[1] Closing wounds with court plaster shuts out the air and creates conditions favorable for the growth of the tetanus germ.

[2] In 1903 there were in the United States 406 deaths from tetanus following 4449 Fourth-of-July injuries, while in 1907, when antitoxin was more extensively used, there were only 62 deaths from 4413 injuries.

Other disease-producing bacteria in the soil. Several other germs that are relatives of the tetanus germ have their home in the soil and in dirty water. One of these (*Bacillus aërogenes capsulatus*) produces a terrible inflammation and swelling. A wound that is infected with this germ is filled with gas and has a very ill-smelling odor, and the inflammation is likely to run into gangrene. This bacillus, like the tetanus bacillus, does not often grow in an open wound. It is dangerous enough, however, to give another powerful reason for looking after wounds and protecting them from dirt. Another relative of the tetanus bacillus causes the disease called "black-leg" in cattle.

POINTS TO BE REMEMBERED

1. The tetanus bacillus has its home in the soil and is commonly found about stables.
2. It enters the body through wounds.
3. Usually it grows only in deep wounds and in wounds that dirt gets into.
4. Wounds of a kind that are especially likely to bring on tetanus should be looked after by a physician.
5. The toxin of the tetanus germ is extremely powerful.
6. Tetanus antitoxin is more useful in preventing tetanus than in curing it.
7. It is advisable to give a dose of tetanus antitoxin as a preventive measure when a wound that may cause the disease to develop has been received.
8. Several dangerous bacteria besides the tetanus bacillus live in the soil.
9. The presence of these germs in earth makes it the more necessary to care for wounds.

CHAPTER NINE

THE AIR PASSAGES AND THE LUNGS

THE air passages consist of the *nasal chambers* (nose), the *pharynx* (throat), the *larynx* (voice box), and the *trachea* (windpipe) and its branches (*bronchial tubes*). The lungs are composed chiefly of air passages (bronchial tubes), some of which are very fine, and of millions of little air sacs that lie at their ends. The tonsils are two rounded elevations in the side walls of the pharynx. A tube from each of the middle ears opens into the pharynx.

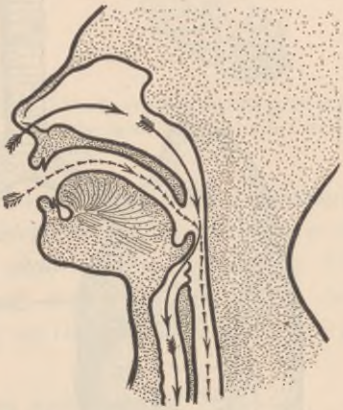


FIG. 24. The solid arrows show the path of the air to the lungs; the dotted arrows show the path of the food to the stomach.

Why bacteria are abundant in the air passages. The air passages have a warm, moist lining on which many kinds of germs can grow and multiply. They open to the outside air, and germs that enter either the nose or the mouth can reach any part of the air passages or the lungs. In the colder parts of our country, respiratory diseases (diseases of the air passages and lungs) are the most common of all ailments, and about one fourth the total number of deaths is due to them.

Bacterial diseases of the air passages and lungs. Among the common bacterial diseases of the air passages are *colds*, *catarrh*, *influenza*, *tonsillitis*, *bronchitis*,

diphtheria, and *whooping cough*. The most dangerous diseases of the lungs are *consumption* and *pneumonia*,

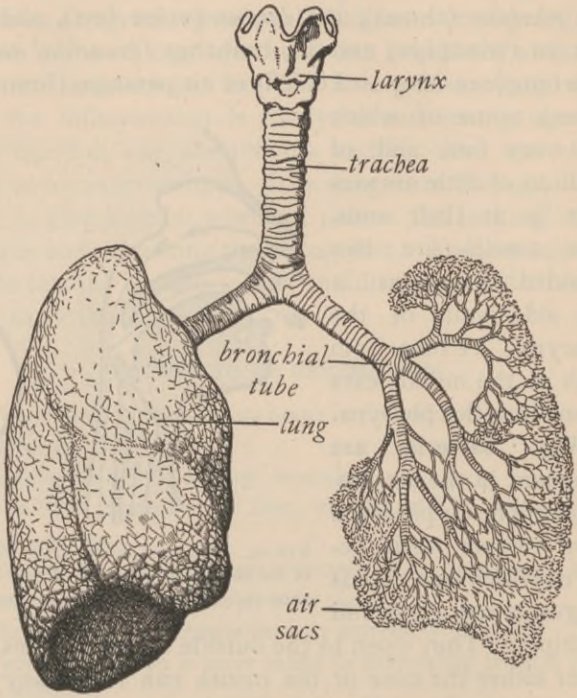


FIG. 25. The lungs.

which in the United States stand at the head of the list of germ diseases as causes of death.

The importance of guarding against respiratory diseases. Simply reading the above list of diseases will convince you that *it is very important to destroy the germs of respiratory diseases.* It will also convince you

that *it is very important to guard the entrance to the air passages.* It is difficult, however, to guard against these bacteria, because they are very widely scattered among mankind, and because they reach the hands more easily than the germs of any other diseases and pass more readily from one person to another. *It is exceedingly important, therefore, to keep up the health as a defense against colds, pneumonia, consumption, and other respiratory diseases.* Recent experiments prove that fresh air increases the resistance of animals to germs, and all experience indicates that outdoor life, outdoor sleeping, and good ventilation are most important in building up the defenses of the body.

FIG. 26. Air sacs that lie at the ends of the small bronchial tubes in the lungs.

POINTS TO BE REMEMBERED

1. The air passages and lungs are favorable places for the growth of germs.
2. In the colder parts of our country, one fourth of all deaths are due to bacterial diseases of these parts.
3. The germs of respiratory diseases are widespread.
4. The germs of these diseases should be destroyed, and the entrances to the air passages should be guarded.
5. The greatest protection against some respiratory diseases is a strong, healthy condition of the body.
6. Fresh air strengthens the body against the germs of these diseases.

CHAPTER TEN

DIPHTHERIA

Some cases of diphtheria are so severe that death comes in a day or two. Other cases are so light that they are mistaken for colds in the head or for simple sore throats. The disease is most common in children, and there is always an increase in the number of cases when the children come together in school after the long vacation. The incubation period is usually from two to eight days, but may be less.

The germ of diphtheria. The diphtheria germ is a bacillus. It grows most frequently in the throat, but often it is found in the mouth, nose, and larynx.[1] It may grow also on the lips, on the lining of the eyelids, and in other parts of the body.

Fig. 27. The bacillus of diphtheria.

The diphtheria bacillus does not usually grow outside the human body, except when it gets into milk. In most cases it is killed by drying, but when it is protected by matter about it, the bacillus can live for some time. On slate pencils that had touched the lips of children who were in the early stages of diphtheria, the germs were found to be alive after several days, and in dried "membranes" from the throats of diphtheria patients it is known that the germs can live for months.

How diphtheria germs get into the body. Diphtheria germs enter the body by way of either the mouth or the nose. They are passed from one person to another

[1] Diphtheria of the larynx is the disease often called membranous croup.

in various ways. They may be coughed out into the air and inhaled,[1] or by spitting they may be spread about in a most dangerous manner. They are almost certain to be on the handkerchiefs of the persons who are carrying these germs, and they can easily get on door-knobs, books, or furniture. They have been found on public drinking cups, and they may be on pencils, chewing gum, pieces of candy, toys, or any of the other objects that are handled and passed around by children. A number of diphtheria epidemics have been caused by milk (page 154), and flies may carry the germs about and leave them where they will reach the mouth and throat. Cats suffer from diphtheria and spread the disease, and other domestic animals probably do the same.

FIG. 28. Diphtheria germs have been found on pencils.

Difficulties in controlling diphtheria. In spite of quarantining and the use of antitoxin, there were over

[1] In coughing, sneezing, laughing, and to a certain extent in talking, small droplets of liquid are sent out into the air. They may fly to a distance of several feet (three to nine), and some of them are so very fine that they are said to float in the air for as long as twenty minutes. When a person is suffering from a disease like diphtheria, pneumonia, or consumption, these droplets are, of course, filled with the germs of the disease. One should not stand near a person who is coughing, and a sick person should hold a handkerchief or a paper napkin before his face when he coughs.

17,000 deaths from diphtheria in the United States during 1912. The chief difficulty in stamping it out is that the germs often linger in the throat for four or five weeks, and occasionally for several months, after recovery from an attack of diphtheria. The germ is found also in the throats of a considerable number of healthy persons[1] (often in those who have been in contact with cases of the disease), and in the noses and throats of persons who seem to be suffering only from ordinary colds or from light cases of sore throat. As a fire sometimes bursts forth into flames again after it seems to be dead, so diphtheria, after it seems to have disappeared, often breaks forth anew from these germ carriers. For at any time one of these persons may pass on to others germs that will cause the most severe cases of the disease; or if his resistance to the germs runs low, he himself may be overcome by them.

Quarantining in cases of diphtheria. To control diphtheria, every one who is carrying virulent diphtheria germs must be shut up in quarantine, whether he be sick or well. It should be understood that in doubtful cases it is not possible for a physician to tell by looking at the throat whether or not

[1] Investigations indicate that when diphtheria is in a city or town, from three to five healthy persons in every thousand carry virulent diphtheria germs in their throats. In these persons the body is holding the germs in check so that they cannot multiply enough to produce the disease, but it is not able to destroy them entirely. The difficulty of controlling the disease is still further increased by the fact that there seem to be harmless races of the germs, and it is not desirable to shut up in quarantine any persons except those who are carrying the dangerous varieties.

it is free from diphtheria bacilli. To determine this, a microscopical examination for the germs must be made.[1]

Diphtheria toxin. The diphtheria germ occasionally produces death by causing the throat to close, but the usual cause of death in diphtheria is the very powerful toxin. So poisonous is this toxin that a patch of diphtheria germs the size of the thumbnail growing on the tonsil may produce toxin enough to cause death. The toxin attacks especially the nervous system, the kidneys, and the heart.

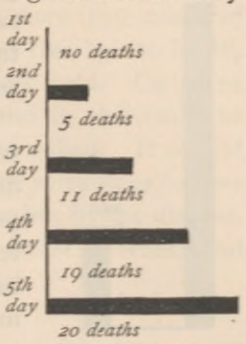


FIG. 29. Showing the number of deaths in 100 cases of diphtheria when antitoxin is used on the first, second, third, fourth, and fifth days. The sooner antitoxin can be used in this disease, the better. The figures are taken from the experience of the London hospitals.

The antitoxin treatment for diphtheria. In a former chapter (page 12) we learned that when disease germs produce toxin in the body, the body works up an antitoxin to destroy the toxin and save itself from being poisoned. Working in accordance with this principle, scientists have learned how to get a diphtheria antitoxin from the

[1] In December, 1908, eight cases of diphtheria appeared in Richmond, Virginia, for which there seemed to be no cause. It was soon learned that all these diphtheria patients except one were using milk from the same source, and the farm from which the milk came was investigated. Every one at the farm was in good health, but in the throats of two of the milkers diphtheria germs were found. This incident shows not only how diphtheria may be spread by healthy persons, but also how efficient health officials can help to save people from disease.

blood of the horse.[1] When a person is attacked by diphtheria, some of the antitoxin from the horse is injected into the body. This does not kill the diphtheria germs, but destroys their toxin and saves the cells from poisoning until the body can kill out the germs and so stop the disease.

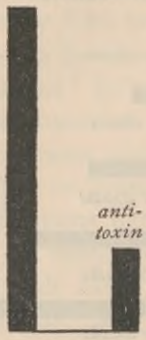


FIG. 30. When no antitoxin is used in the treatment of diphtheria, about forty-four patients in a hundred die. When antitoxin is used, there are only one fourth as many deaths (eleven in a hundred).

It is very important that the antitoxin be given in the early stages of diphtheria, for after the toxin has poisoned the cells of the nervous system, kidneys, and heart, great damage has been done, and it is not possible to undo it. Antitoxin is useful in all stages of the disease, however, and should always be used. It is also very useful in preventing diphtheria, and when a person has been exposed to the germs, a dose of antitoxin is often given to prevent the development of the disease.

The results of the antitoxin treatment. From the very beginning of its use in the treatment of diphtheria,

[1] The antitoxin is prepared in the following manner: Diphtheria germs are placed in beef broth, where they multiply and produce great amounts of toxin. A little of this toxin is then injected into the blood of a horse, and the horse begins to work up antitoxin to destroy it. A larger dose of toxin is then given to the horse, and still more antitoxin appears in the blood. More and more of the toxin is injected, until the blood of the horse is made as strong in antitoxin as possible. Then the horse is bled and the blood allowed to clot. The thin yellow liquid (serum) that appears around the clot contains the antitoxin. After being freed from certain impurities, this serum is sealed up in glass containers and sold as antitoxin.

antitoxin has been a great success. Indeed, when antitoxin is given in the very early stages of the disease, there are almost no deaths. This is shown by the experience of Richmond, Virginia, in the last four months of 1908. During this time there were 139 cases of diphtheria. Antitoxin was furnished free by the health department of the city, and was freely used. Only one of the 139 cases ended in death, and in this case the child was dying before a doctor was called. It should be understood that the paralysis which sometimes follows diphtheria is not caused by antitoxin, but by the disease. After an attack of diphtheria the heart is weak, and violent exercise should not be taken.

POINTS TO BE REMEMBERED

1. The diphtheria germ usually grows only in the body, but it may live for some time outside the body.
2. It is transferred from one person to another in many different ways.
3. It is often found in the throat long after the patient has recovered, and is occasionally found in the throats of healthy persons.
4. Every one who is carrying virulent diphtheria germs should be quarantined, whether he is sick or well.
5. The diphtheria germ produces a very powerful toxin that poisons especially the cells of the nervous system, the kidneys, and the heart.
6. By injecting diphtheria toxin into a horse, the blood of the horse can be made very strong in antitoxin.
7. If this antitoxin is used when a person is attacked by diphtheria, it saves the body from being poisoned.

CHAPTER ELEVEN

PNEUMONIA

Up to about ten years ago consumption caused more deaths in all parts of our country than any other germ disease. Now a better understanding of how to avoid the germ of consumption, and a better knowledge of how to treat the disease, have considerably lessened the death rate from consumption; and in some of our northern states the pneumonia germ now claims more victims than any other of our microbe enemies. In 1912 it caused about 125,000 deaths in the United States. Pneumonia is much more common in cities than it is in the country, probably because in a city, where the people are crowded together, the germ is more easily passed from one person to another, and because fresh air is less abundant in the city than it is in the country.

The character of the disease. Pneumonia usually begins with a chill (often a very severe one), cough, fever, pain in the side, and rapid breathing. The sputum has a rusty color caused by blood from the air sacs of the lungs. The disease runs a swift and severe course, the crisis coming usually in from three to eight days. In rare cases death is caused by the closing of the air sacs in so great a portion of the lungs that the patient cannot breathe, but more commonly the heart is overwhelmed by the toxin that is carried from the diseased lungs by the blood. Pneumonia attacks particularly children under five years of age, aged persons, and those who for any reason are weak or sick. Users of alcohol are especially liable to pneumonia, and all physicians know that drinkers fare badly when attacked by this disease.

The germ of pneumonia. Pneumonia may be caused by a number of different germs, but in most cases a small coccus (the *Pneumococcus*) is the invader. This germ grows not only in the lungs but also in the nose, mouth, throat, and air passages; in children it is a very common cause of inflammation in the middle ear, and it is sometimes the cause of meningitis. The pneumonia germ attacks many animals, and it is possible for man to get the disease from animals.

FIG. 31. The pneumonia germ (*Pneumococcus*).

How pneumonia germs enter the body. Pneumonia, like diphtheria, is an infectious disease. The germs are in the sputum and often in the discharges from the nose of a pneumonia patient; they are passed from one person to another in all the ways that diphtheria germs are spread abroad (page 37); and they enter the body through the mouth or nose. The germs are killed by drying, and outside of the body they quickly die.

Pneumonia germs in the mouths of healthy persons. Pneumonia germs are quite often found in the mouths of healthy persons. These germs are real pneumonia germs, and they are capable of causing the disease, as experiments with animals show. Yet they are not nearly so vigorous and powerful in causing the disease as are germs fresh from the lungs of a pneumonia patient, and in an epidemic of pneumonia it would seem that an especially virulent race of germs had broken loose.[1] It is therefore not advisable to expose one's

[1] In camps where men live in close contact with each other, an exceedingly fatal form of pneumonia sometimes develops. At such times the germ

self to germs from a pneumonia patient, for a person who may be holding in check a race of weak pneumonia germs may very readily fall a victim to a stronger race of the same germs.[1] The sputum and the discharges from the nose of a pneumonia patient should by all means be carefully destroyed.

FIG. 32. Kiss the baby on the cheek, not on the mouth.

Preventing pneumonia by keeping up the health. The pneumonia germ is one of the most widespread of disease germs, and it is not always possible, try as we may, to avoid it. During pneumonia epidemics, therefore, it is advisable to make a special effort to keep up the general health so that the body may be able to kill any pneumonia germs that may reach the lungs. To keep up the health a person should avoid all exposure to wet and should wear sufficient clothing to protect himself from cold. He should avoid alcoholic drinks, for users of alcohol are especially likely to have pneumonia, and the man whose power to resist germs is

is probably passed on from one pneumonia case to another, and grows in the human lungs until it becomes especially adapted to this kind of home.

[1] A physician reports the following as occurring in a rural community: An elderly woman suffered a severe attack of pneumonia. Two women from neighboring families who helped care for her contracted the disease. The husbands of these women were next stricken, and two other persons also were attacked. Two of the seven cases ended in death.

lessened by drink falls into the hands of a terrible foe when the pneumonia germ attacks him. A person should also eat good food, take plenty of sleep and exercise, and should spend as much time as possible in the open

FIG. 33. Pneumonia patients being treated in the open air. (*After photograph of patients in the Presbyterian Hospital, New York.*)

air. Anything that builds up the general health is a safeguard against pneumonia, and anything that weakens the body may bring on pneumonia. For the germ is already in the mouths and throats of millions of people, waiting for a chance to grow.

The importance of fresh air. There is little doubt that the resistance of the body to pneumonia germs is often weakened by a lack of fresh air. By many it is believed that the large number of pneumonia cases in February and March is to be accounted for on the theory that we have been weakened by living indoors all winter, often in houses that are not sufficiently ventilated. Physicians and boards of health are more and more recommending fresh air as a means of keeping up

the health, and in treating pneumonia some of the most successful physicians carry the patients outdoors even in the coldest weather, as is done in the treatment of consumption. Any one who wishes to keep up his resistance to the pneumonia germ cannot afford to neglect the fresh air factor.

POINTS TO BE REMEMBERED

1. Pneumonia causes more deaths in our country than any other germ disease except consumption.
2. It runs a swift course, and death is usually due to toxins that are carried out of the lungs in the blood.
3. Pneumonia may be caused by several different germs, but it is nearly always due to a small coccus (the pneumococcus).
4. This germ may grow in other parts of the body besides the lungs, and attacks animals as well as men.
5. The pneumonia germ spreads by contact infection and enters the body through the mouth and nose.
6. Pneumonia germs are found in the mouths of many healthy persons.
7. In epidemics of pneumonia, virulent and especially dangerous races of the germ are abroad.
8. The sputum of pneumonia patients should be destroyed, and pneumonia should be treated as an infectious disease.
9. The pneumonia germ is widespread, and we should keep up the health and the germicidal power of the body to protect us from this disease.
10. Fresh air is one of the greatest factors in building up the resistance of the body to pneumonia.

CHAPTER TWELVE

INFLUENZA, WHOOPING COUGH, AND COLDS

INFLUENZA

INFLUENZA (grip) was little known in the United States until 1889–1890. Then a great epidemic swept over the country, and the disease has been common with us ever since. It is, however, an ancient disease, and epidemics of it were common in Europe in the Middle Ages. It was also common in other parts of the world before its recent introduction into the United States. Usually it causes in the United States about 12,000 to 15,000 deaths a year, and in 1907 it caused over 20,000 deaths.

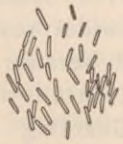


FIG. 34. The germ of influenza.

The germ of influenza. The germ of influenza is a very small bacillus, one of the smallest disease-producing bacteria known. It grows in the mouth, the throat, the trachea, and the bronchial tubes, and occasionally is the cause of pneumonia. Influenza germs linger for a long time, sometimes for more than a year, in the air passages of those who have had the disease, and they are often found in the bronchial tubes of consumptives and of persons who suffer from bronchitis. The germ is in the sputum and in the discharges from the nose, and enters the body through the mouth and nose. The influenza bacillus is easily killed by drying, and in nature it does not grow outside the human body.

Influenza a serious disease. The influenza germ produces a powerful toxin that has a profound effect upon the whole body. It does not poison the body so acutely as does the toxin of the diphtheria germ, but it causes

a depression and weakness that often last for months. Another bad feature of the disease is that other troubles, such as pneumonia, consumption, eye and ear diseases, bronchitis, and colds, often follow it, and it may leave a part of the body, as the stomach, the kidneys, or the nervous system; in a weakened condition. Because it is so widespread, because its after-effects are so serious, and because a person may have it again and again, influenza is a much-dreaded disease.

Guarding against influenza. Influenza germs are spread abroad in about the same ways that diphtheria and pneumonia germs are scattered. No attempt is made to quarantine influenza patients, and usually there is great carelessness about disinfecting the sputum. Influenza germs are therefore spread everywhere, and great numbers of persons are attacked by the disease.[1] Every care should be taken to avoid the germs, and the hands, dishes, and handkerchiefs of an influenza patient should be carefully disinfected. Aged persons and persons who are weak should be guarded with especial care from the germs.

FIG. 35. In droplets that are coughed out into the air the germs of influenza, colds, and other respiratory diseases are found (see footnote, page 37).

WHOOPING COUGH

Whooping cough is caused by a small bacillus (*Bordet-Gengou bacillus*, or *Bacillus pertussis*). The germs grow

[1] In January, 1908, more than one third of the people in Chicago were suffering with influenza at one time.

in the bronchial tubes and are in the sputum, especially in the early part of the disease. The incubation period is usually from four to fourteen days, but it may be as long as three weeks, and the "whoop" may not show itself for some time after the commencement of the attack. Whooping cough is highly infectious from the beginning, and any one who is thought to be taking it should not be allowed to remain in school. As a general rule, a child may be permitted to return to school in six weeks after the beginning of the whoop, provided the severe coughing spells have ceased.

Whooping cough dangerous to children. Whooping cough is not usually supposed to be very dangerous, and often cases of it are not carefully quarantined. As a consequence, it is a widespread disease and causes more deaths than scarlet fever and smallpox combined — more than any of the other common infectious diseases of children. Some persons make no effort to protect their children from whooping cough, or even purposely expose them to it. This is a most pernicious practice, for more than four fifths of all deaths from whooping cough are among children under two years of age. The older a child is, the better he resists the disease, and an adult usually either escapes it altogether or has a mild attack.

Quarantining in cases of whooping cough. To children under five years of age, whooping cough is a very dangerous disease, and cases of it ought not to be allowed to run unchecked with the idea that every one must have it. During quarantine the patient need not be shut up indoors, but he ought to keep away from others who might become infected with the germs. A vaccine is now prepared that will often prevent the disease. It

will also shorten and lessen the severity of the attack if used promptly when the first symptoms appear. Dogs and cats suffer from whooping cough, and during epidemics they may be a means of spreading the germs.

COLDS

Colds are caused by germs that are transferred from one person to another. In no other way can the fact that they run in epidemics be explained.[1] They are the most common of all the germ diseases of temperate climates, and the most difficult to avoid. The germs pass easily from one person to another, and it is astonishing how quickly an epidemic can spread through a community.

A B

FIG. 36. Germs that are common causes of colds. *A* is the Pneumo-bacillus; *B* is Micrococcus catarrhalis.

The germs that cause colds. During a cold, there are great numbers of bacteria growing in the air passages. Often several different kinds unite in causing the trouble. In many cases pneumonia or influenza germs are the chief invaders; often pus-forming bacteria (especially streptococci) are present; a certain bacillus (*Pneumo-bacillus*), which at times causes pneumonia, is very commonly one of the principal germs; sometimes a small coccus (*Micrococcus catarrhalis*), which is often found in catarrh, is one of the causes of the ailment; and occasionally an epidemic

[1] I have long been satisfied from observation that people often catch cold from one another when shut up in close rooms and coaches, and when sitting near and conversing so as to breathe in each other's transpiration. — BENJAMIN FRANKLIN.

cold is found to be due to the diphtheria bacillus. There are, therefore, a number of germs that can grow in the lining of the nasal chambers and the throat and cause inflammation, and when this happens, we say we have a cold.

FIG. 37. Benjamin Franklin, who was one of the shrewdest men and one of the best scientists of his day. More than a hundred years ago he observed that people catch colds from each other.

Catarrh and bronchitis. Catarrh is a chronic cold, and bronchitis is a cold of the lining of the trachea and bronchial tubes. The small coccus (*Micrococcus catarrhalis*) that is sometimes present in ordinary colds is very frequently found in chronic catarrh, and the pneumonia germ and pus-forming bacteria (streptococci) are common in cases of bronchitis. Chronic catarrh and bronchitis are difficult diseases to cure, and they should not be allowed to fasten themselves on children.

Avoiding the germs that cause colds. A person who is trying to avoid the germs of colds should not borrow pencils, books, or other articles from any one who has a cold; he should not touch soiled handkerchiefs, use public drinking cups, or stand near any one who is coughing without turning away from him; he should keep his hands away from his own mouth and nose, and should frequently wash his hands thoroughly with soap and water (page 161). He should also avoid wet

feet, chilling the body, alcoholic drinks, or anything else that will lower his resistance to germs. A person who has a cold should change handkerchiefs frequently, turn

FIG. 38. One way in which the germs of colds and other respiratory diseases may be passed from one person to another.

away from others when he coughs, disinfect his hands occasionally, and in other ways try to prevent the spread of the germs.

POINTS TO BE REMEMBERED

1. Influenza is caused by a small bacillus that is passed from one person to another in ways that do not allow it to dry.
2. Influenza is a serious disease, and the germs should be avoided as much as possible.
3. Whooping cough is a serious disease, and should be quarantined.
4. Colds, catarrh, and bronchitis are caused by germs growing in the air passages and throat.
5. These diseases are infectious, and care should be taken to prevent the spread of the germs.
6. Keeping up the resistance of the body is an important safeguard against colds.

CHAPTER THIRTEEN

TUBERCULOSIS

PROBABLY from the earliest times, mankind has been afflicted with tuberculosis, for a great Greek physician named Hippocrates wrote a treatise on consumption in 400 B.C., and in the lungs of Egyptian mummies the marks of consumption have been found. At the present time *Bacillus tuberculosis*, or the *tubercle bacillus*, as it is sometimes called, is the most deadly of all the bacterial enemies of man. In our own country, more than one tenth of all deaths are caused by this germ, which means that the "Captain of the Men of Death" is killing our fellow-countrymen at the rate of 150,000 a year, over 400 a day, and one every three and a half minutes. Years ago Oliver Wendell Holmes called consumption the Great White Plague, and it richly deserves the name.

The cost of tuberculosis. Because tuberculosis selects its victims especially from those who are in the active working years of their lives,[1] and because it is a lingering illness, it costs us far more in money than does any other disease. It is difficult to calculate the cost of sickness in dollars and cents, but one estimate that has been widely accepted places the cost of tuberculosis to our country at a billion dollars a year. Just how great a sum this is you will realize better when you know that it is more than two sevenths as much as the yearly wages of all the factory workers in the United States, nearly one half more than the whole country spends on its public and high school system, and nearly ten times as much as it spends on its colleges and universities. Yet the

[1] One third of all deaths between the ages of fifteen and forty-five are from tuberculosis.

death rate from tuberculosis has fallen amazingly in the last thirty years, and it would be a simple matter to prevent nearly all cases of the disease.

The germ of tuberculosis. The germ of tuberculosis is a slender bacillus. It is a slow-growing bacterium, but it is a very hardy one, and often it resists all attempts of the body to kill it and grows steadily on until it causes death. Outside the bodies of men and animals it does not grow at all in nature, and light and drying kill it. Yet in a dark, damp house the germs in the sputum of a consumptive may live for several months or perhaps for a whole year. Away from the habitations of men and animals the tubercle bacillus is not found, but it is often present in the earth and refuse about places where cattle are kept, and in the rooms of careless consumptives.

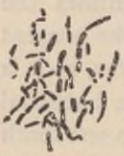


FIG. 39. The bacillus of tuberculosis.

Different forms of tuberculosis. The tubercle bacillus may grow in almost any part of the body and cause tuberculosis of the part attacked. Tuberculosis of the lungs, or consumption, is the best-known form of the disease, and causes by far the most deaths. Tuberculosis of the bones is also a common trouble, and most of the lame and crippled people that we see have been deformed by tuberculosis of the spinal column, or of the bones of the hips, legs, or feet. Tuberculosis of the bones is especially common among children, as is also scrofula, or tuberculosis of the lymphatic glands. Tuberculous meningitis, which causes more deaths than any other form of tuberculosis except consumption, is more common among children than among older persons. The skin, kidneys, intestine, larynx, and other parts of the body also may

be attacked by this germ; and when the tubercle bacillus is growing anywhere in the body, it is always possible for it to be carried by the blood to the lungs.

How the tuberculosis germs enter the body. It is not possible in most cases of tuberculosis to tell how the germ got into the body. There is no doubt, however,

FIG. 40. Many of the lame and crippled people that we see have been deformed by tuberculosis of the bones.

that some cases come from breathing in germs from dried sputum and from droplets that have been coughed out by consumptives, and that many other cases come from germs that have been swallowed and that have passed through the walls of the intestine into the blood. It is probable that the germ gets into the body by way of the mouth more commonly than was formerly supposed.

How tuberculosis germs are scattered. The form of tuberculosis that is most dangerous to those about the patient is consumption. In this disease, the germs may be coughed out into the air in droplets of saliva, they may be carried by flies if all sputum is not carefully de-

stroyed at once, and they may be spread abroad in all the ways that pneumonia and diphtheria germs are scattered (page 37). Dishes that have been used by a consumptive are a source of danger unless they are disinfected, and food that a consumptive has prepared or touched may contain the germs. The tuberculosis germs may also be in milk or water, they may be carried on the feet from sidewalks and other places where people spit, and in almost countless other ways these germs can reach the mouth and nose. They can withstand considerable drying, and in dried sputum they remain alive and virulent after the germs of most other common diseases would be dead. This makes especially dangerous the habit of spitting that some careless consumptives have, for in the advanced stages of the disease several billion germs are thrown off daily from the lungs. Indeed, it is not right for any one to spit in public places, for it is probable that more than one half of the people in our country who have consumption, do not know that they are afflicted with the disease.

FIG. 41. A waterproof pasteboard sputum cup. These are very cheap and they should be burned after being used.

Disinfecting sputum. The importance of destroying the sputum of consumptives cannot be too strongly insisted on. It should be received either in pasteboard cups that can be burned, or in a vessel that contains a disinfectant. Carbolic acid is a good disinfectant to use for this purpose, but lysol is better, for it dissolves the mucus of the sputum and allows the disinfectant to get quickly to the germs (page 160). When the consumptive is traveling, the sputum may be

received in waterproof envelopes or pocket sputum cups that are made for the purpose, or on pieces of cloth that may be carried in a paper bag until a fire is reached. The sputum should not be swallowed, for if this is done, the germs may set up intestinal tuberculosis, or they may pass through the intestinal wall, be carried away in the blood, and start the disease in some part of the body that has not yet become infected. Under no circumstances should the sputum be allowed to dry, for in the dry condition it is impossible to keep the germs from being scattered about.

FIG. 42. A pocket sputum cup, to be burned after being used.

Other precautions to be taken. A consumptive should hold a paper napkin or a handkerchief before his face when he coughs, and these napkins or handkerchiefs should be burned, or placed in a disinfectant, or kept in water until they can be boiled. A consumptive should learn to keep his hands away from his face and mouth, and should occasionally wash his hands in a disinfectant. He should have his own dishes, and these should never be washed with other dishes, nor allowed to come in contact with them until after being boiled for at least five minutes. His bedclothes, clothing, and furniture ought occasionally to be disinfected, or at least exposed to the bright sunshine as much as possible, and his clothing should be boiled before it is washed with other clothes. A consumptive should have a sleeping room to himself, and this room should be kept bright and well ventilated, to help kill any germs that may be free in it. A house in

which a consumptive has lived should be disinfected before any one else moves into it.

Danger from a consumptive. In Indiana in 1910 the state health officials investigated more than 900 new cases of consumption and found that in more than half of them the patient had been living or working with a consumptive. These and other recent studies indicate that those who live with consumptives run a great risk of becoming infected with the germs (page 200). A consumptive should, therefore, take great care not to endanger those about him.

FIG. 43. This house stands at the edge of a small village. Sunshine and pure country air are abundant about it, but the house is infected with tuberculosis germs. In six years three different families lived in it, and each of these families had one or more members stricken with consumption while living in the house.

Alcoholism and tuberculosis. In a former chapter (page 15) it was stated that alcohol lessens the power of the body to kill germs and that the death rate from consumption is much higher among brewers than among ministers. We should like at this time to call your attention again to the fact that the person who uses alcohol makes himself more liable to tuberculosis. In the sanatoria for consumptives in Loslau, Germany, in 1899, 94 per cent of the patients were drinkers and only 6 per cent were abstainers. So closely connected are the use of alcoholic drinks and tuberculosis that in Paris, in 1905, the International Tuberculosis Congress adopted the following resolution: "*We strongly emphasize the*

necessity and importance of combining the fight against tuberculosis with the struggle against alcoholism."

TUBERCULOSIS IN ANIMALS

Tuberculosis is a common disease of chickens and turkeys, but the tubercle bacillus of birds does not seem to be able to attack man. Many domestic animals also suffer from tuberculosis, the disease being especially common among cattle and among hogs that have run in barn lots with tuberculous cattle or have been fed on milk from infected cows. The tubercle bacillus of cattle and of hogs (the "bovine type") of the germ can grow in the human body. It attacks children much more frequently than it does older persons, and it usually grows in the bones, in glands, or in the walls of the intestine, rather than in the lungs.

Tubercle bacilli in milk. The tubercle bacillus may at times get into the body from meats, but infection from milk is much more important. Where the disease is allowed to run uncontrolled, from 15 to 30 per cent of dairy cattle have the disease, and from 5 to 9 per cent of the milk sold in certain of our cities has been found to contain living tuberculosis germs.

Danger from the bovine type of the tubercle bacillus. The bovine variety of the tubercle bacillus is fitted for growth in the body of the cow rather than in the human body, and it is believed to be much less virulent for man than is the "human type" of the germ that is usually found in the sputum of a consumptive. The question of tuberculosis among cattle is an important one, however; for 10 per cent of all deaths from tuberculosis among children under five years of age are due

to the bovine type of the germ, and many thousands of other persons are being infected by these germs each year. A very simple and certain method of testing cattle for tuberculosis has been discovered, and even if there were no danger of man's getting the disease from milk, tuberculous cattle should be separated from those that are free from the disease. This is economy; for by taking out of a herd all the animals that have tuberculosis, the spread of the disease in the herd can be stopped. Milk from a dairy that is not known to be free from tuberculosis should be Pasteurized before it is used (page 156).

POINTS TO BE REMEMBERED

1. Tuberculosis costs the United States 150,000 citizens each year, and it is estimated that its annual cost in money is $1,000,000,000.
2. The tubercle bacillus is slow-growing, but it is very difficult to kill.
3. In tuberculosis any part of the body may be attacked, but consumption is by far the worst form of the disease.
4. The germs enter the body either by being inhaled or by being swallowed.
5. They withstand drying and are scattered in many ways.
6. The sputum of consumptives is full of germs, and it should be burned or disinfected.
7. Most cases of consumption are contracted by contact infection, and a careless consumptive is dangerous to those about him.
8. The tubercle bacilli that are often present in milk are dangerous to man.
9. Milk that may contain tubercle bacilli should be Pasteurized.

CHAPTER FOURTEEN

THE TREATMENT OF CONSUMPTION

THE steady manner in which consumption often runs on and on has caused many persons to think that it is an incurable disease. This is a great mistake. The Germans say that " every one is a little bit tuberculous," and this is almost the truth. The bodies of five hundred persons who died from diseases other than tuberculosis were examined, and in all but fifteen of them tubercle bacilli were found in some part of the body. Even in the lungs of most grown persons there are scars showing where tubercle bacilli have started to grow and have been checked. It is a very common occurrence for the tubercle bacillus to start its growth in the lungs and to be checked by the body without the person who is being attacked ever knowing what is happening. If consumption is taken in hand before the germs have gained a secure foothold, it yields to treatment much more readily than many other bacterial diseases.

The importance of early treatment. In the treatment of consumption, everything depends on beginning in the early stages of the disease (Fig. 44). One who has symptoms [1] of consumption, therefore, should not try to persuade himself that his symptoms have no existence, for this will not stop the growth of the germs. He should not lose valuable time experimenting with patent medi-

[1] The most common symptoms of consumption are cough, loss of appetite, gradual loss of weight and strength, fever in the afternoon, night sweats, and blood spitting. The cough may be absent in the very early stages of the disease, or it may be troublesome only in the early morning and after going to bed at night. Any one who loses weight or finds himself becoming tired easily, should have himself examined at once, even though he have no cough.

cines, for there is no medicine known that will cure consumption. The only sensible thing for him to do is to be examined at once by a physician who thoroughly understands the disease. Then, if he finds that the

FIG. 44. The amounts of white in *A*, *B*, and *C* show the chances that a consumptive in the early, moderately advanced, and advanced stages of the disease has of being cured or of having his disease arrested. These figures are from the experience of the State Sanatorium at Rutland, Massachusetts. From 1889–1907 this institution treated 1911 persons who were in the early stages of consumption, and in 1450 of them the disease was apparently cured or arrested. Of moderately advanced cases 1616 were treated, and in 604 of them the disease was apparently cured or arrested. Of more advanced cases 784 were treated, and in only 147 was the disease apparently cured or its progress stopped. These figures show the very great importance of early treatment of the disease.

germs have gained a foothold in his lungs, he should give himself the best possible treatment without delay.

Important factors in treatment. In the successful treatment of consumption, the following are the more important factors: —

Rest. If a consumptive can be kept quiet, much of the toxin that is produced by the germs will be thrown off in the sputum. Anything that causes the breathing to be quickened and deepened causes more of the toxin to be carried from the lungs through the body, and increases the fever.

A consumptive should therefore have rest. If he has

fever, he should have absolute rest, not even walking about his room. Laughing and loud talking should be avoided, and coughing should be refrained from as much as possible. When there is no fever, a little exercise may be taken, but it should be taken with care.

Food. A consumptive should have an abundance of nourishing food, especially of fatty food. Meat, eggs, milk, and any other good foods that he can eat and digest should be taken. Lunches should be eaten between meals and on retiring. The foods must be well prepared and served in different ways, or the patient will become tired of them. "Stuffing" a patient, however, may cause indigestion, and the diet of a consumptive should be looked after carefully.

FIG. 45. An outdoor sleeping place, of a kind that most consumptives can have.

Outdoor life. Nothing in the treatment of consumption is more important than fresh air, and the disease has been most successfully treated when the patients have lived and slept in the open air, summer and winter. Often an upper porch can be arranged as a sleeping place. In outdoor sleeping in winter, it is necessary to have warm clothing and to wear some kind of hood to protect the head and neck, and in many places in summer it is necessary to screen the patient from mosquitoes.

Other important points. Warm and dry clothing is of

course important. If a consumptive lives indoors he should be sure, above all else, to have plenty of fresh air. Consumption is much more frequent in damp houses and on wet soils than it is in dry houses and on sandy soils.

FIG. 46. Consumptives taking the winter air on a city roof.

A consumptive should not remain in a damp house, and if he lives outdoors, it should be on a dry soil.

Finally, every consumptive should have a skilled physician to watch over and guide him in his treatment of himself, and he should secure some of the many books and circulars that have been written on consumption and its treatment, and learn how to live in a way that will give the best possible chance for recovery.[1] He should

[1] A splendid little book on consumption, written by Dr. S. A. Knopf, is sold by *The Survey*, 105 East 22d Street, New York, and 116 South Michi-

always think of the safety of others and should take care not to endanger those about him. He should be cheerful and hopeful, for if he takes his disease in time he has every reason to expect recovery.

FIG. 47. Window tents can be bought that allow a consumptive to obtain fresh air through an open window while his body remains in bed in a warm room. This tent was designed by Dr. S. A. Knopf.

The effect of climate on consumption. It was formerly supposed that climate was very important in the treatment of consumption, but in all our states consumptives are now being cured, and it has been found in treating this disease that rest, food, and fresh air are of much more importance than climate. Unless a consumptive

gan Avenue, Chicago, for 25 cents in paper or 50 cents in cloth. Many state and city boards of health publish very valuable bulletins and circulars that are distributed free to any one writing for them, and a consumptive can easily learn where other books on the subject may be bought.

has money enough to support himself without work and to give himself proper care, he should not leave his home for a distant state. For in many places consumptives are not welcomed, and it is better to be at home and have the proper care than to be without money or friends in the best climate in the world. In general, a cold, dry climate is best for consumptives, and they should avoid hot, moist climates and high elevations.

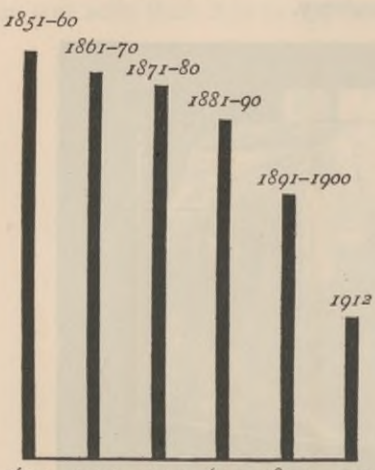


FIG. 48. Diagram showing the tuberculosis death rate in Massachusetts since 1851 for each 100,000 inhabitants. If the present rate of decrease can be continued, the disease will disappear by 1930.

Sanatoria for consumptives. Many states have established sanatoria to which consumptives can go and, at a slight expense, remain until they recover from the disease. This is sensible, for in a sanatorium a consumptive can have proper food and care at much less expense than he can have them at home, and in sanatoria the spread of the disease is stopped. It is much more economical for the people of a state to care for their consumptives in sanatoria than out of them, and it is much pleasanter and better for the patients. In checking the spread of tuberculosis, sanatoria have been a wonderful help — perhaps a greater help than any other one thing.

Inheritance and consumption. Consumption is often spoken of as an inherited disease, and it is true that some families are more afflicted by it than are other families. This does not mean that children in these families are born with tuberculosis germs in their bodies, but it means that they are born with less power of killing these germs than most people have. *People who come of consumptive families cannot have consumption unless they get tubercle bacilli into their lungs*,[1] and if they can avoid the germ, they may be as well and strong as any one. It should be understood that persons who move into houses that are infected with tubercle bacilli often contract the disease, although there may be no history of consumption in their families. It is true also that those who have married consumptives or who have lived in houses with them die of the disease almost as often as

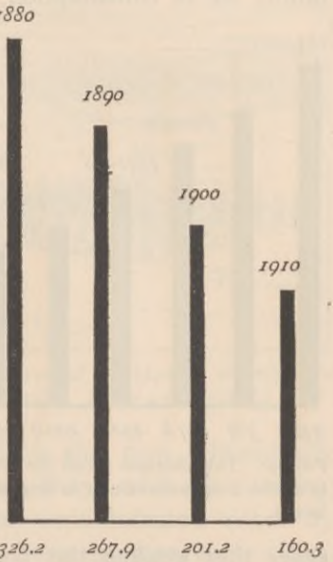


FIG. 49. This diagram shows the gradual decrease in the number of deaths from tuberculosis in the United States. The numbers given are the deaths per 100,000 in the part of the United States where statistics have been carefully kept.

[1] A tendency to consumption may be inherited, just as a tendency to drunkenness may be inherited. But without whisky or other alcoholic drinks we can have no drunkenness, and without the tuberculosis germ we can have no consumption. — DR. ENNION G. WILLIAMS.

do the brothers and sisters or the children of consumptives (page 200).

These facts show that when several members of a family die of consumption, the trouble is not so much a matter of inheritance as that the healthy members of the family get the germ from those who are sick. A person who is of a consumptive family should therefore not worry about the disease being inherited, but should try to keep himself from being exposed to the germs; he should be careful about pneumonia, grip, measles, colds, and other diseases that weaken the body so that the tuberculosis germs are able to attack it successfully; he should avoid alcohol and other things that will injure his body, and try to lead a healthful life. Above all he should make sure that he secures an abundance of that great upbuilder of the body, *fresh air.*

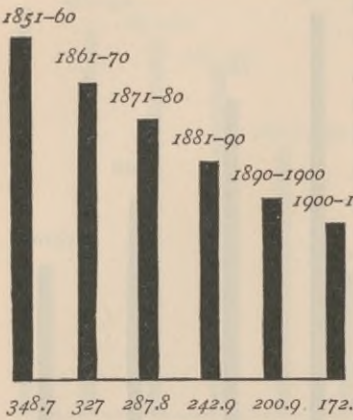


FIG. 50. This diagram shows the decrease in deaths from tuberculosis in England and Wales.

Progress in the prevention of tuberculosis. As we have seen, no germ has so spread itself through all society and has so extended its ravages to all parts of the world as has the tubercle bacillus. Yet the world is not full of tubercle bacilli. The air of the fields and woods, the streams of the forests and mountains, and the soil of

the fields, are free from them. The millions of people who in the past have died of tuberculosis germs got these

FIG. 51. Tent sanatorium for consumptives of the Modern Woodmen of America at Colorado Springs, Colorado. (*After a photograph.*)

germs from either sick cattle or sick men. Practically all the millions of people now living who are carrying these germs in their bodies were infected either by human sputum or by milk. Some persons, some cities, some states, and some nations have to a greater or less degree known these facts for some years, and in some places a warfare on the Great White Plague has been started. This warfare has been most successful. Examine Figure 48 and you will see that not one third so many people are now dying of tuberculosis in Massachusetts as died of it in that state sixty years ago. Examine Figure 49 and you will see that what is true of Massachusetts is true also, to a great extent, of other parts of the United States; and Figure 50 shows that not only in our own country but also in other countries

has this great enemy of mankind been checked. "Tuberculosis is communicable, preventable, and curable," is the battle cry of the anti-tuberculosis host, and in that host hope swells high in every breast, for already in many places the battle line of the enemy has been broken, and his forces are being driven back. Much of the work that is being done has as yet hardly begun to show its effects, but the results prove clearly that it is not necessary for people to die of tuberculosis as they are dying now.

POINTS TO BE REMEMBERED

1. In curing consumption, the most important point is to begin treatment in the very early stages.
2. In its early stages consumption is curable.
3. Rest, food, and fresh air are the important factors in the treatment of the disease.
4. Climate is not so important in the treatment of tuberculosis as was formerly supposed.
5. Sanatoria are to be recommended because in them the patient can have the care that he needs, and in them there is no danger of the spread of the disease.
6. The germ of tuberculosis is not inherited, but some persons do inherit only a slight resistance to the germ.
7. A person who belongs to a consumptive family should take especial care to avoid the germ and to keep up his health.
8. Great progress has been made in the war against tuberculosis, and those who are fighting the disease are very hopeful for the future.

CHAPTER FIFTEEN

DUST AND GERM DISEASES

In a cubic yard of ordinary air there are from a hundred to a thousand bacteria. These bacteria are clinging to particles of floating matter of one kind and another; for they themselves are heavier than air, and by themselves they would fall to the earth like little stones. Air that is free from dust is therefore free from bacteria also, and by stirring up dust the number of bacteria in the air can be increased to a multitude. How very abundant small floating particles are in the air may be seen when a ray of sunshine enters a darkened room through a narrow opening.

Disease germs in dust. People who are forced to breathe dusty air always suffer greatly from sore throats, catarrh, bronchitis, pneumonia, and consumption. It was formerly believed that these diseases were air-borne, but later studies have shown that, generally speaking, the bacteria in the air are of harmless varieties; that disease germs die when they are exposed to light or thorough drying, and that dust under ordinary conditions is not an important carrier of germs. Nevertheless, it is true that in a weak light germs may remain alive in sputum or in mucus from the nose until these discharges are dry enough to be powdered up and blown about in the air. We cannot, therefore, say that indoor dust, such as is stirred up by sweeping a schoolroom, is always free from germs.

How germs get into dust. Practically all the disease germs that are in dust *have been spit into it by human beings*. If you will count up the dangerous germs that may be in saliva (the germs of consumption, pneumonia,

influenza, diphtheria, catarrh, bronchitis, colds, meningitis, infantile paralysis, whooping cough, scarlet fever, and measles), you will understand at once why every one should refrain from spitting on floors and in public

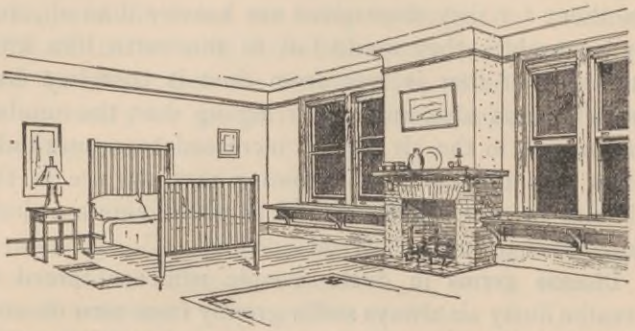


FIG. 52. In a light and well-ventilated room germs are killed by the light and drying.

places, especially in places where the sunlight has not an opportunity to kill the germs.[1]

The greatest danger from dust. Dust is dangerous chiefly, not because it carries germs into the air passages, but because it wounds the lining of the air passages and allows the germs that have already gotten into these parts in other ways to set up their growth. That this is the most important effect of dust is shown by the fact that dust that is absolutely free from germs, like that breathed in by stone cutters or metal grinders, causes those who breathe it in to suffer from respiratory diseases. Dust itself is, therefore, a cause of disease,

[1] According to the newer ideas of sanitation the chief danger in spitting lies in the fact that the germs in the fresh sputum are often carried about until they reach the hands and food of other persons.

and everything possible should be done to keep it from flying in the air.

Keeping down dust. Streets should be sprinkled, and where it is possible they should be cleaned by washing instead of by sweeping them. Houses should be swept with carpet sweepers or damp brooms, and some damp material should be used in sweeping schoolrooms and other public buildings.[1] Schoolrooms should be swept after school, so that there will be time for the dust to settle before the pupils assemble the next morning, and other public buildings should be swept some time before they are to be used. Dusting should be done with a damp cloth that will wipe off the dust and take it away, for it is simply foolish to stir up the dust into the air, where it will be inhaled or will settle again on objects in the room. In rooms that are much used, hard floors, rugs, and

FIG. 53. The wrong way to remove dust from furniture.

[1] The Michigan State Board of Health recommends the following preparations for use in sweeping the floors of public buildings: —

(1) To a pailful of sawdust wet with hot or cold water add one half pint of kerosene and a tablespoonful of sulpho-naphthol or formaldehyde.

(2) Heat one third part sand, and add two thirds part sawdust. To a pailful of this mixture add one half pint of paraffin oil (kerosene may be used) and mix thoroughly. This preparation produces excellent results.

(3) Boil one pound of sal soda and one pound of chlorid of lime (bleaching powder) in a gallon of water. Dampen sawdust to be used for sweeping with this solution. This preparation is excellent for restoring the natural color of floors.

plain furniture are more hygienic than heavy carpets and plush-covered furniture, because it is easier to keep them free from dust. Vacuum cleaners are recommended by health officials, because they remove dust and do not stir it up where it will be breathed into the lungs.

Preventing dust in manufacturing processes. Dusty trades (for example, pottery, metal grinding, stone cutting, and cotton weaving) are exceedingly unhealthful, and in some of these trades respiratory diseases (especially consumption) claim a majority of the workers unless measures are taken to guard against the breathing in of the dust. In some of the processes, the workman protects himself by wearing a mask, while streams of water used to keep down the dust and air blasts arranged to carry the dust away are each year saving hundreds of workers from death by diseases of the air passages and lungs. It is right that the workers in these trades should be protected; for dust, whether it be in the home, school, or factory, is a cause of disease.

POINTS TO BE REMEMBERED

1. Bacteria are in the air only when floating matter or dust is in the air.
2. People who are forced to breathe dust suffer from respiratory diseases.
3. Indoor dust may contain disease germs.
4. The disease germs in dust come from the sputum of human beings.
5. Dust is dangerous chiefly because it wounds the walls of the air passages and allows germs to start their growth.
6. Every possible effort should be made to keep down dust.

CHAPTER SIXTEEN

THE ALIMENTARY CANAL

THE alimentary canal is a long passageway through the body. Its principal divisions are the mouth, throat, esophagus, stomach, small intestine, and large intestine. Like the air passages, the alimentary canal has warm, moist walls that afford a good place for the growth of germs. The juices of the stomach contain an acid that keeps most bacteria from growing in that part of the alimentary canal, but in the long reaches of the small intestine a number of germs grow and cause disease.

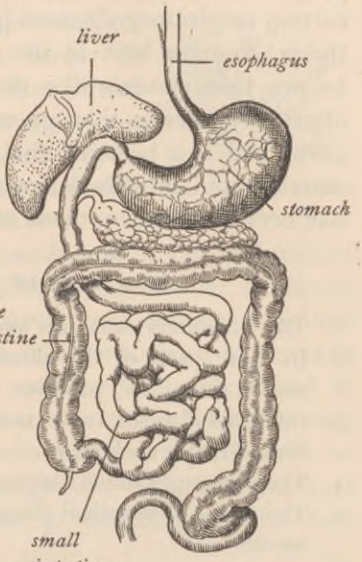


FIG. 54. The alimentary canal.

Bacterial diseases of the intestine. Among bacterial diseases of the intestine are typhoid fever, cholera, dysentery, diarrhea, and meat poisoning. This group of diseases causes yearly in the United States over 100,000 deaths, or about one thirteenth of all the deaths that occur; and of these 100,000 deaths about 70,000 are among children under two years of age. It should be understood that intestinal diseases are much more easily prevented than are respiratory diseases, for the

germs of nearly all of them die when thoroughly dried, and the mouth is the one point that needs to be guarded to keep these germs out of the body. Another point that should be noted is that intestinal diseases are most to be dreaded in the warmer parts of the earth, while certain respiratory diseases (pneumonia, influenza, diphtheria) flourish best in the colder regions. It is now known that animals like the dog, cat, rat, and mouse often carry germs that are near relatives of the typhoid germ, and it is believed that many sudden outbreaks of diarrhea and intestinal trouble are caused by food that has been infected by these animals.

POINTS TO BE REMEMBERED

1. The alimentary canal is a long tube through the body.
2. In some parts of the alimentary canal, especially in the mouth, throat, and intestine, bacteria grow abundantly.
3. Intestinal diseases cause more than 100,000 deaths in the United States each year.
4. These diseases attack children especially.
5. The germs of intestinal diseases enter the body through the mouth.
6. Animals may infect food with germs that cause intestinal diseases.

CHAPTER SEVENTEEN

TYPHOID FEVER

TYPHOID fever is found in all climates and in all countries where man dwells. It is usually a severe disease, but during some cases ("walking typhoid") the patient is hardly ill enough to go to bed. In the United States it is rapidly decreasing, but it still causes more than 20,000 deaths each year. The incubation period is from seven to twenty-one days.

FIG. 55. The typhoid germ.

Typhoid fever an important disease. The importance of typhoid fever is not shown by the number of deaths that it causes. For every person who dies from typhoid fever there are six or seven others who must be watched over through the anxious weeks of an attack, and of these a considerable number rise from their sickness with weakened kidneys, lame backs, crippled limbs, or other injuries that last through life. There are at least 200,000 cases of this disease in the United States each year.

The typhoid germ. The germ of typhoid fever is a plump bacillus. It is fitted to live in a liquid, and swims freely. It enters the body through the mouth and attacks especially the walls of the small intestine, but in cases of typhoid the germ is found in the blood and all through the body. Meningitis, pneumonia, and ulcers in the bones are caused by this germ, and the "rose spots" that appear on the abdomen in most cases of typhoid fever are caused by the germs growing in the skin. The germs leave the body in the discharges

from the bowels and kidneys,[1] and occasionally in matter vomited by a typhoid patient. They may be in the perspiration, and if they are growing in the lungs, they will be found in the sputum.

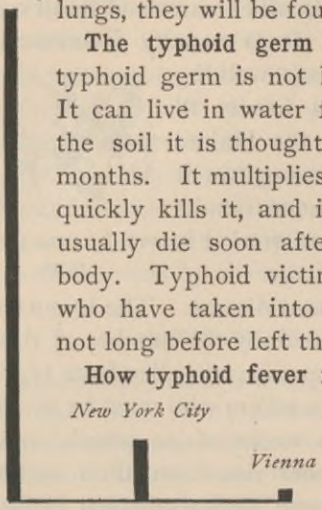


FIG. 56. Diagram showing the number of deaths from typhoid fever for each 100,000 inhabitants in Pittsburg, New York, and Vienna in 1907. At that time the people of Pittsburg were drinking the polluted Ohio River water, New York had a good water supply, and Vienna secured its water from the melting snows on the mountains.

The typhoid germ outside the body. The typhoid germ is not known to attack animals. It can live in water for several weeks, and in the soil it is thought that it lives for several months. It multiplies rapidly in milk. Drying quickly kills it, and in general, typhoid germs usually die soon after they leave the human body. Typhoid victims are therefore persons who have taken into their mouths germs that not long before left the body of some one else.

How typhoid fever is contracted. Persons in the same house with a typhoid patient may get the germ on their hands by handling bedding or in a hundred other ways. Flies will carry the germs in great numbers if all wastes from a typhoid patient are not carefully destroyed. Occasionally the germs are in oysters that have been grown in polluted waters, and for this reason cooked oysters are safer than raw ones. In a

[1] In about 25 per cent of typhoid cases, the germs are in the urine, sometimes in enormous numbers (100,000,000 to 500,000,000 in a cubic centimeter, or 5,000,000 to 25,000,000 in a single drop). This must be carefully disinfected, or it will prove a most dangerous source of infection.

large number of cases, the typhoid germ has been carried in milk where some one having the disease has handled the milk, or where the milk vessels have been washed in water containing the germs.[1] In many other cases typhoid is contracted from water. In a later chapter we shall discuss the subject of disease germs in drinking water (page 86).

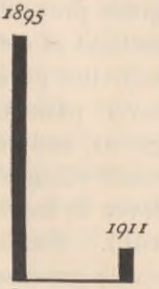


FIG. 57. In 1895 Chicago ran its sewage into Lake Michigan, from which its water supply was obtained. A drainage canal now carries most of the sewage away from the lake. The diagram shows the decrease in the death rate from typhoid fever, following the improvement of the water supply.

Germ carriers. It has been found that a considerable number of persons who have typhoid carry the germs long after recovery from the disease. The germs usually locate themselves in the gall bladder and keep on passing into the intestine. One cook in New York gave the disease to twenty-seven persons in five years; a cook in Richmond, Virginia, gave the disease to ten persons in four widely separated houses. In one case the germs were found in the discharges from the body forty-two years after recovery from the disease. As yet it has not been possible to free these persons from the germs, and they are a constant source of danger to all about them.

[1] In 1907 a case of typhoid fever occurred in a mountain house near Palo Alto, California. The wastes from the patient were thrown into a stream on which a dairy was located some distance below. The milk cans at the dairy were washed in the stream, and a typhoid epidemic of 236 cases developed among the people who were supplied with this milk. In the spring of 1908 one milkman in Boston who was suffering with typhoid caused an epidemic of over 400 cases.

The prevention of typhoid fever. Typhoid fever is one of the most easily prevented of all diseases. The great preventives of it are pure drinking water, a safe method of disposing of human sewage, destroying carefully the germs that come from the bodies of typhoid fever patients and others who are carrying typhoid germs, and removing the breeding places of flies. In small villages and on farms, the great cause of typhoid fever is leaving human wastes exposed to flies (page 191). Vaccination against typhoid fever is now extensively practised in armies, hospitals, communities where the disease is unusually prevalent, and among those who for any reason may run an unusual risk of being exposed to the disease. The vaccine treatment is proving very valuable as a preventive measure (page 205).

POINTS TO BE REMEMBERED

1. There are annually at least 200,000 cases of typhoid fever in the United States.
2. All cases of typhoid are caused by germs that have come from the human body.
3. The germs enter the body through the mouth, very frequently in water.
4. Some persons carry the germs long after they have recovered from the disease.
5. Pure drinking water, proper disposal of sewage, destroying all wastes that contain typhoid germs, and the removal of the breeding places of flies are the great factors in the prevention of typhoid.
6. Vaccination against typhoid fever is now successfully practised.

CHAPTER EIGHTEEN

DISEASES CAUSED BY RELATIVES OF THE TYPHOID GERM

THE causes of some of the germ diseases of the intestine are not well understood, as so many different bacteria are found growing in the intestine that it is sometimes impossible to be sure which one is causing the trouble. Among the germs frequently found in the intestine are several that are closely related to the typhoid bacillus. In this chapter we shall study some of the more important and best-known of these germs.

The colon bacillus. The colon bacillus is very much like the typhoid bacillus. It is always found in the intestine of man and of all the higher animals. Usually it feeds on the contents of the intestines and does no harm, but when the body is weakened (as by hot weather), or perhaps when a more powerful race of the germs gets into the intestine, the colon bacillus seems to be a cause of diarrhea and other troubles.

The bacillus of dysentery. *Chronic* dysentery is caused by a protozoön; this disease we shall study in a later chapter (page 131). The sudden attacks of *acute* dysentery, which sometimes run in epidemics, are caused by a bacillus that differs very little from the typhoid bacillus.[1] This is a severe disease, and one that is greatly feared by armies. In different parts of the United States there are epidemics of it every summer. The germs are scattered in the same ways that typhoid germs are scattered, and because the disease is a very dangerous one, all matter from a dysentery patient should be carefully destroyed.

[1] Acute dysentery is often called *flux*.

Meat poisoning. Meat poisoning (often called *ptomaine* poisoning) is caused by at least two different germs. The most common form of the disease is caused by a bacillus of the typhoid group that attacks cattle, horses, hogs, and goats. The germ is in the flesh before the animals are killed, and in a few cases epidemics of the disease have been caused by unprincipled butchers who killed sick animals and sold the flesh. Meat infected with this germ does not differ in appearance or taste from wholesome meat.

The other form of meat poisoning is caused by a bacillus that is a relative of the germ of tetanus. It gets into the meat after the animal is killed, and meat containing this germ sometimes has a bad odor. This bacillus does not grow in the human body, but in its growth in meat it produces a toxin which violently poisons the body. Thorough cooking will destroy the toxin, and meat poisoning of this kind is usually caused by sausages that are bought and eaten without further cooking. This germ gets into meat from dirt, and meat that is to be used as food should be handled in a cleanly manner.

POINTS TO BE REMEMBERED

1. The colon bacillus is always found in the intestine, and at times causes mild forms of disease.
2. Acute dysentery is caused by a bacillus that resembles the typhoid germ in appearance and in the way it is spread.
3. Meat poisoning is due to bacteria that are found in the flesh of diseased animals, or that get into meat from unclean handling.

CHAPTER NINETEEN

OTHER BACTERIAL DISEASES OF THE INTESTINES

DIARRHEA and inflammation of the intestine are important causes of death, especially among young children. All together these troubles cause in our country over a

FIG. 58. In the Federal armies, during the four years of the Civil War, 110,070 soldiers were killed in action or fatally wounded. During the four years from 1903–1907, in the United States, 271,773 children under two years of age died from diarrhea and other similar diseases. The height of the child and the height of the soldier show the relative number of deaths in each case.

hundred thousand deaths a year. They are most to be feared in the summer, the time when children are weakened by the heat, and the time when germs multiply most rapidly in water and in foods. The germs enter the body in water, milk, and other foods. Flies are especially responsible for the spread of these diseases.

Germs that cause diarrhea. It seems probable that any one of several different kinds of bacteria may cause

diarrhea and inflammation of the intestine. In some cases pus-forming bacteria (sometimes streptococcus, sometimes Bacillus pyocyaneus) seem to be the guilty germs. In other cases it is probably the colon bacillus. Probably mild attacks of typhoid fever and dysentery are sometimes mistaken for simple diarrhea. The disease is infectious, and germs from a sick person should be destroyed.

Weak and strong races of intestinal germs. It is probable that among the germs that commonly grow in the intestine there are different races, some more powerful than others. It is also probable that new races of these germs give us more trouble than those to which we are accustomed; for water that does not seem to trouble those who use it daily will often start intestinal disturbances in visitors and travelers. This is probably because those who drink the water from day to day become accustomed to the germs in it and their systems learn to resist them, while a stranger is not prepared to overcome germs of these particular races.

Cholera infantum, or summer complaint, in children. It has not been possible to prove that any one germ is the cause of cholera infantum. In a number of epidemics the bacillus of dysentery has been discovered, but in many cases other germs seem to be the cause. The trouble seems to be that in summer babies are weakened by the heat until they have little resistance to germs, and at the same time the milk which is fed to babies is kept warm until it swarms with multitudes of bacteria of many different kinds. *To prevent cholera infantum the milk must be kept clean and cold*, and it should be used as fresh as possible. The milk vessels

and the bottles should be thoroughly washed and scalded to kill germs that are on them, and no impure water that is likely to contain germs capable of causing diarrhea should ever be given to a little child.

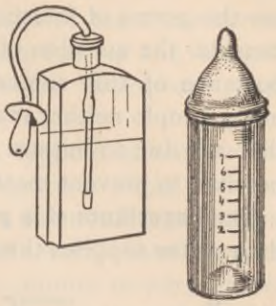


FIG. 59. The wrong kind of nursing bottle and the right kind. The bottle with the long, slender tube and the narrow mouth is hard to keep clean; the bottle with the wide mouth may be cleansed easily.

Indigestible foods that will lie in the intestine and form a breeding place for germs should not be given to young children. Children should be given all the fresh air possible, and their general health should be built up in every way, so that they will be able to resist germs. *It should be remembered that cholera infantum is infectious, and any person who is caring for a little baby should keep the baby away from the disease.* Isolating the patient and disinfecting the body wastes has proved one of the most effective methods of checking the spread of the disease.

POINTS TO BE REMEMBERED

1. Diarrheas are caused by several different germs.
2. It is probable that there are weak and strong races of these germs.
3. Cholera infantum is generally caused by germs in milk.
4. Babies should be carefully looked after, so that they will be able to resist the germs of intestinal diseases.
5. Diarrheas and cholera infantum are infectious.

CHAPTER TWENTY

DISEASE GERMS IN WATER

THE disease germs that are most common in water are the germs of intestinal diseases. We shall therefore consider the question of a pure water supply. The importance of this subject is often not appreciated, for many people neither realize the great number of deaths that are due to impure water nor understand that it is possible to prevent most of these deaths.

The importance of a pure water supply. By filtering their water supplies through beds of sand, Albany, New York, and Lawrence, Massachusetts, have saved two thirds of the people who would have died of typhoid fever, if they had continued drinking impure water. Vienna changed from the polluted Danube River water to a pure water supply, and found that its death rate from typhoid was only one thirtieth what it had been. Certain towns in the Philippine Islands now use artesian water, and in those towns there are only about one half as many deaths as there were when impure water was used.

FIG. 60. For many years Pittsburg had the highest death rate from typhoid fever of any of the large cities of America. Can you tell why?

Germ diseases that are contracted from water. The diseases that are most frequently contracted from water are cholera, typhoid, dysentery, and diarrhea. The

germs of these diseases come from the bodies of human beings, reach water that is used for drinking purposes, and get back to the human mouth. In our country, typhoid fever is the most important of the water-borne diseases, although in the southern half of the United States dysentery and diarrheas are widespread and serious diseases.

Not only are the deaths from typhoid and other intestinal diseases reduced by using pure water, but for some reason a marked decrease in the number of deaths from pneumonia, tuberculosis, and several other diseases seems to follow changing from impure to pure water. The reason for this decrease is not yet fully understood. It is known, however, that in pneumonia, influenza, diphtheria, and tuberculosis the germs are practically always in the wastes from the alimentary canal, and tubercle bacilli have been found in the water of a stream that received the drainage of a tuberculosis sanatorium. It seems probable that the germs of respiratory diseases live in water and that many persons contract these diseases through impure drinking water.

How disease germs get into drinking water. Usually, disease germs either get into water from sewage or are washed into the water from soils that have been polluted with wastes from the human body. They may get into a well or cistern if a person who has germs on his hands works around the pump or handles the water buckets; a stream may be polluted by washing clothes from a diseased person in it, or by a diseased person bathing in it; but in general, disease germs are washed out into waters from polluted soil. The following history of the typhoid epidemic that occurred in Plymouth,

Pennsylvania, in 1885, shows how the water supply of a town may be infected with germs. During the winter of 1884–85, a man living on the bank of a stream that flowed into the town reservoir was stricken with typhoid fever. The wastes were thrown out on the snow, and in the spring the waters from the melting snows and the rains washed these germs into the water supply of the town, and typhoid fever suddenly broke out. The city had a population of about 8000, and during the height of the epidemic from 50 to 200 persons a day were attacked. All together there were 1104 cases and 114 deaths. People who drank from wells escaped, and there is no doubt that the germs came from the public water supply.

Epidemics like the one in Plymouth are, of course, uncommon, but if you will investigate you will probably find that in the town or community in which you live, several persons die each year from diseases that are mainly due to water.

Dangerous waters. Any water that comes from the surface of the ground is likely to contain disease germs. Shallow wells, springs, and small streams are the most dangerous of all waters. It is not safe to use water from these sources, no matter how clear and pure it may seem; for in the country, where people drink chiefly from wells, typhoid fever is more common than it is in our most crowded cities, and in the mountain regions, where the people drink from the most beautiful clear springs and streams, typhoid is a great scourge. Experience shows that intestinal diseases follow the drinking of surface water, and it is not the part of wisdom to fail to profit by the experience of those who have lived before us.

Safe waters. In general, waters that do not come from the surface of the ground are safe. Deep artesian wells (except in rare instances in mountain regions) furnish water that is absolutely safe. Rain water that is caught and stored away in tanks above the ground is safe also. There is a common idea that dangerous germs may be blown up on a roof in dust, but the germs of intestinal diseases die if they are thoroughly dried, and are not found in rain water that has been kept from touching the ground. Underground cisterns that are thoroughly cemented are much safer than wells. Yet there is danger of ground water getting into a cistern around the top, or if part of the pipe that carries the water from the roof is underground, germs may easily get into the cistern through this pipe. There is also danger of germs falling into an underground cistern from the platform above. Distilled water is perfectly safe, but some bottled spring waters contain bacteria.

Keeping germs out of wells. In country regions wells will probably be the principal source of drinking water for many years, and it is important that they be made as safe as possible. In guarding a well from dangerous germs, the following are the chief precautions to be taken : —

Keeping surface water out of wells. Very few bacteria live deeper than three or four feet in the ground, and water, as it comes from the ground into a well that is as much as twenty feet deep, is usually free from germs. In most cases the pollution of the water in such a well comes from the surface water getting into the well when it rains and carrying with it germs from the upper layers of the soil.

To keep a well free from dangerous bacteria, it should first of all be located on high ground and away from all pigpens, stables, or other outbuildings. Under no circumstances should any puddles of water be allowed near it. Around the mouth of the well a tough clay should be spread and packed in thoroughly,

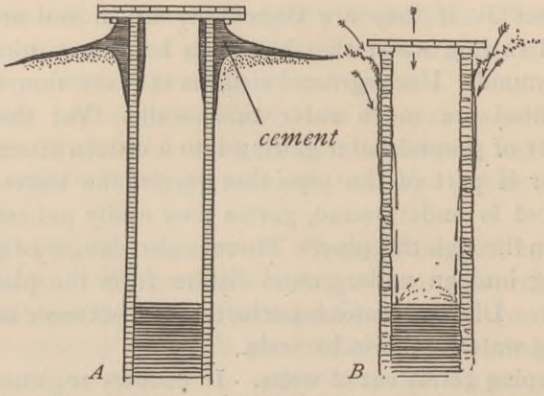


FIG. 61. *A* shows a well so arranged that surface water and germs are kept out of it. *B* shows how surface water and germs get into a well.

to form a water-tight layer over the soil. This should slope so as to carry all water away from the well. The whole task is to keep surface water out, and this can be done still better by cementing the upper part of the wall and laying a circle of cement over the surface of the soil, as is shown in Figure 61. The platform should be wide enough to keep any surface water whatever from running down in behind the wall and getting into the well.

The above precautions will do much to keep out of a well not only bacteria that are in the soil, but matter on

which bacteria can feed and multiply. Yet if the earth about a well is polluted (as it is in thickly settled regions where there are many dry closets), some germs are certain to find their way into the water. For this reason it has often been necessary in towns and cities to fill up

FIGS. 62 and 63. From which well would it be safe to drink the water?

wells, and where there is reason to think that a well has been the cause of disease, the use of water from it should certainly be stopped.

Keeping germ carriers away from wells. No person who is sick, or who is caring for a case of infectious disease, should work with well buckets or about a pump. Neither is it safe to use water from a well where many people handle the rope and buckets, for we are finding that germ carriers among healthy people are so common that there is always danger that one of them may have been about the well. Any person who walks over ground that has been polluted with human wastes (as

many dooryards are) and then stands on a well platform, may leave disease germs where they will get into the water. For this reason, a well should always have a clean, sound platform, built of two layers of boards to make it as nearly water-tight as possible, and the pump should be so arranged that water will not run back into the well around it. A well that is covered by a small house and from which water is pumped by a windmill is much easier to make safe than one in the open, from which the water is taken by a hand pump or drawn out by buckets.

Freeing water from disease germs. It is the duty of every city either to secure pure water for its inhabitants, or, by filtering or in some other way, to remove dangerous germs from the water that it sends to the homes of its people. Many cities fail to do this, however, and when one is compelled to use impure city water or water from an ordinary well or spring, the best plan is to boil it. Simply bringing it to the boiling point will kill all dangerous germs (page 158). Most house filters are almost useless, and some of them are worse than useless, for they catch and hold matter in which bacteria breed and multiply, and the bacteria pass through the pores in most of them. Very fine porcelain filters, if they are carefully cleaned and attended to, do strain out bacteria, but they work very slowly, it is a great deal of work to care for them, and it is easier to boil water than to look after one of them. Filtering through animal charcoal takes certain coloring matter out of the water and makes it look clear and bright, but it does not remove germs. It is always to be remembered that to use fruits, vegetable dishes, or milk vessels that have been

washed in impure water may be as dangerous as to drink the water.

The importance of boiling drinking water. Boards of health frequently send out warnings when it is necessary for the inhabitants of a city to boil their drinking water, and if these warnings were always followed, thousands of cases of sickness would be saved each year. All over the country, people are drinking from wells into which surface water is draining, and if these families would boil their water (or repair their wells) thousands of lives would be saved each year.

FIG. 64. Water like this is free from disease germs unless it has been polluted by wastes from the bodies of the sick.

The fact that water is clear is no indication that it is free from germs, for germs are so small that they cannot be seen by the unaided eye. Because people have been drinking water from a well for a hundred years is no indication that the water is pure, for it is possible for a well to have been in good condition twenty-five years ago and to be receiving

surface water now. It is possible, too, that many of the people who have drunk water from the well during the hundred years have died of diseases that they contracted from the water. Do not make the mistake of thinking that a well can be made safe by cleaning it out occasionally. Typhoid germs live longer in clean water than in dirty water, and a well can be made safe only by keeping disease germs out of it.

POINTS TO BE REMEMBERED

1. Nothing is more important in preventing germ diseases than pure drinking water.
2. Intestinal diseases in particular are spread through water.
3. The disease germs in water come from the human body.
4. They get into the water from germ-laden wastes, from the hands of germ carriers, and in other ways.
5. Great epidemics of typhoid fever and cholera have been caused by polluted water.
6. Water from the surface of the ground (water from streams, springs, and shallow wells) is unsafe for drinking.
7. Artesian water is usually safe, as is rain water that has been kept free from pollution.
8. To keep wells free from germs, surface water and dirt from the platform must be kept out of them, and persons who are carrying germs should be kept away from them.
9. Impure water should be boiled before it is drunk.

CHAPTER TWENTY-ONE

OTHER BACTERIAL DISEASES

BESIDES the diseases we have already studied, there are many other diseases of man that are caused by bacteria. Most of these are tropical diseases, and we shall not even mention them here. In a considerable number of other diseases the particular germ that is responsible has not been surely determined, and we cannot tell whether these diseases are due to bacteria or to protozoa. There is also a great number of bacterial diseases of animals, and a considerable number of bacterial and fungous diseases of plants, for animals are seldom sick, and plants are almost never sick, unless they are attacked by germs. In this chapter we shall take up a few very different diseases that it is well to understand.

MENINGITIS

Every year there are in the United States over 10,000 deaths from meningitis. The disease is caused by germs growing in the membranes around the brain and spinal cord. About two thirds of all cases of this disease are caused by pus-forming bacteria, the pneumonia germ, the influenza germ, the tuberculosis germ, or the typhoid germ. The other cases of meningitis are caused by a special germ (*Meningococcus*)[1] that is not found in other diseases. When meningitis is caused by this germ, it is an infectious disease, often runs in epidemics, and is sometimes called epidemic cerebro-spinal meningitis. Its attack is sudden and severe, and until very recently most cases ended in death.

How the germ of epidemic meningitis enters the body. The germ of epidemic meningitis is abundant in the dis-

[1] Pronounced men-in'-go-kok'-kus.

charges from the nose of a patient who is suffering with the disease. It dies quickly from drying, and does not grow naturally in animals or outside the human body. It is spread in ways that do not require it to be long outside the body, as by handkerchiefs, drinking cups, the hands, or by droplets that have been coughed or sneezed out into the air. It is sometimes found in the noses of persons who have been about meningitis patients, and it is believed that it reaches the brain by working upward through the roof of the nasal chambers. Any one who is carrying this germ should be quarantined, and the sputum and discharges from the nose of a meningitis patient should be carefully destroyed.

FIG. 65. The germ of epidemic cerebro-spinal meningitis.

Curing meningitis. Recently a serum prepared from the blood of the horse has been used in the treatment of epidemic meningitis.[1] This serum contains both an antitoxin and a substance that kills the meningitis germs. It is proving of great value, for of 1294 patients that were treated with it only about 31 per cent died, while of cases that are not treated with the serum, about 70 to 75 per cent end fatally. Like the antitoxins for diphtheria and tetanus, meningitis serum should be used as early in the case as possible.

SORE EYES

Different germs—the diphtheria, the pneumonia, or the pus-forming bacteria—may cause sore eyes, but

[1] This serum is of no value in cases of the disease caused by germs other than the meningococcus.

there is a particular bacterium (*Koch-Weeks bacillus*) that causes the epidemic form of sore eyes often called "pink eye." This germ dies quickly from drying, and is not found to any extent in dust, but it is easily transferred on handkerchiefs, towels, wash basins, on the hands, and by flies, and children with this disease should not attend school. The infected eye should be carefully covered to keep germs from getting into the other eye. It is never safe to wash the eyes in a public wash basin or to wipe them on a public towel (page 197). Any infection of the eyes should be promptly treated by a physician, for continued inflammation may injure the blood vessels and linings of the eyelids.

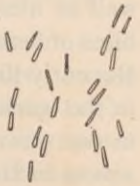


FIG. 66. The bacillus that causes "pink eye."

RHEUMATISM

Acute rheumatism is caused by bacteria that settle in the joints and cause inflammation there. The germ has been thought by some to be a variety of streptococcus. Others think that while it is very similar to streptococcus, yet it is a different germ. When it attacks the valves of the heart, it may cause death.

LEPROSY

Leprosy is caused by an exceedingly slow-growing bacillus that is similar in many ways to the bacillus of tuberculosis. The germ probably gets into the body by being inhaled, or through wounds, or possibly by the bite of the mosquito. It is believed that several lepers have been cured by the use of a new remedy.

BUBONIC PLAGUE

Bubonic plague is the disease that in the Middle Ages was called the Black Death. The germ attacks rats as well as men, and men usually get the disease from the bites of fleas that have been living on plague-stricken rats. Recently there has been a widespread epidemic of plague in the world, the disease being in all the continents and in one year in fifty-two different countries. It is most severe in India, where in 1907 it caused nearly a million deaths. In the United States, plague has succeeded in landing in San Francisco, Seattle, and New Orleans. In San Francisco it was soon exterminated, and in Seattle and New Orleans it is still being fought among the rats. The disease spreads from one country to another by infected rats traveling by ship, and many of our seaports are now rat-proofing the wharves along their water fronts in order to guard against the introduction of this dreaded disease (page 205).

CHOLERA

The cholera germ grows in the intestines and produces a toxin so powerful that death sometimes comes in a few hours. The germs are spread in the same ways that typhoid germs are spread. At the present time cholera is feared only in those countries where the germ theory of disease is not understood. In all countries where people understand the germ theory of disease, cholera has now disappeared.

MUMPS

It is believed that the cause of mumps is a small coccus that grows in the salivary glands. The incubation period is from thirteen to twenty-one days, and the patient is

dangerous to others for a week after the swelling of the glands is gone.

BACTERIAL DISEASES OF PLANTS AND ANIMALS

Bacterial diseases of animals. Among bacterial diseases of animals are the following: Swine plague among hogs; roup, white diarrhea, and cholera among fowls; milk-sickness and black-leg among cattle; distemper and glanders among horses; Malta, or Mediterranean, fever, among goats and cattle; and many other diseases of animals that cannot be mentioned here. The glanders bacillus may attack man (sometimes causing a fatal illness), and milk-sickness and Malta fever may be contracted by man from milk.

Bacterial diseases of plants. Pear blight; a disease much dreaded by orchardists, called crown-gall; the wilt disease of young cucumbers, melons, squashes, and pumpkins; the brown rot of the potato, tomato, and eggplant; the black rot of cabbages, rutabagas, and turnips; a disease of sweet corn; a knot disease of the olive; a rot of the calla lily; and a widespread stem rot of the potato — all these are plant diseases that are caused by bacteria. It is thought that bees carry pear-blight germs from tree to tree during blossoming time, and that they are entirely responsible for the spread of the disease. The germs of wilt diseases are probably spread by beetles and squash bugs that feed on the diseased plants.

FIG. 67. A muskmelon plant that has been attacked by wilt bacteria.

Diseases caused by fungi. Many diseases of plants — rusts, smuts, mildews, many of the rots, and various other diseases — are caused by small plants (fungi) that are similar to molds. These fungi are much larger than bacteria, their bodies being composed of long, thread-like filaments. A few fungi enter the hair follicles and grow in the human skin. Among the diseases caused by them are ringworm, tetter, barber's itch, and a kind of itch that attacks any part of the body. These diseases are infectious, and care is necessary to prevent their spread. Thrush, a white growth found in the mouths of young babies, also is caused by a fungus.

POINTS TO BE REMEMBERED

1. Meningitis may be caused by any one of several germs, but the epidemic form of the disease has a special germ of its own.
2. In epidemic cerebro-spinal meningitis, the germ is in the discharges from the nose of the patient and enters the body through the nose.
3. A new serum is proving very valuable in treating this disease.
4. Great care should be taken to guard the eyes when sore eyes are epidemic, and all cases of infectious sore eyes should be quarantined.
5. Acute rheumatism, leprosy, plague, and cholera are bacterial diseases.
6. Bacteria cause many diseases of animals and plants.
7. Many plant diseases and some skin diseases in man are caused by fungi that are larger than bacteria.

CHAPTER TWENTY-TWO

PROTOZOA

THE bacteria are the smallest of all plants. The protozoa are the smallest of all animals. The smallest protozoa look like tiny specks under the most powerful microscope, and are no larger than very small bacteria. The largest of them are much larger than any bacteria, but they can barely be seen with the naked eye.

Protozoa are abundant in both fresh and salt water. Many of those that live in the ocean have shells, and so

FIG. 68. Phosphorescence in the water is caused by multitudes of protozoa.

abundant are they that great beds of chalk and limestone are built by them. Others are phosphorescent (give off light), and in the warmer seas the waves at night are often fringed with light from the multitudes of protozoa in the water.

Many kinds of protozoa live in the bodies of animals, and almost every animal, from worms and insects up to man, suffers from diseases that are caused by them.

Among the protozoan diseases of man are several that are carried by insects, and these diseases are worse in

FIG. 69. Shells of protozoa in a piece of chalk as seen under a microscope.

the warmer parts of the earth, where insects are most abundant.

In the following chapters we shall consider protozoan diseases and, along with them, several diseases due to very small germs that may or may not belong in the protozoan class (page 194).

POINTS TO BE REMEMBERED

1. Protozoa are very small animals.
2. Protozoa are abundant in both fresh and salt water.
3. They cause many diseases of animals and men.
4. Several protozoan diseases are spread by insects.

CHAPTER TWENTY-THREE

MALARIAL FEVER AND YELLOW FEVER

MALARIAL fever does not cause so many deaths as some other diseases, but because it is found over a great part of the world, and because in malarial countries a great number of people are affected by it for long periods of time, malaria must be counted as one of the most important of the diseases that afflict mankind.[1] No community can prosper as it should while its people have malaria, for a person who is suffering from this disease cannot have the energy and ambition that he should have to carry on his work.

The germ of malaria. Malaria is caused by small protozoa that live in the red blood corpuscles. A malaria germ grows and becomes larger in a corpuscle and then divides into a number of parts, each of which is a young germ. The corpuscles then break into pieces, leaving the young germs free in the blood. Each young germ now enters a fresh red corpuscle, grows in it, and divides into a number of germs. These young germs then break forth and attack other corpuscles.

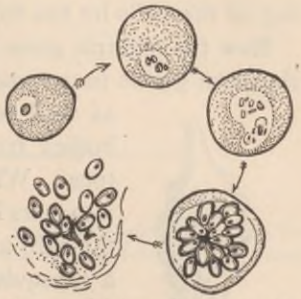


FIG. 70. The growth of the malaria germ in a red blood corpuscle.

The cause of the chill in malaria. While they are growing in the corpuscles, the malaria germs produce

[1] In malarial countries 25 to 30 per cent of the people may have the germ of malaria in the blood. Many of those who are carrying the germ do not have chills and fever and do not know that they have malaria, but they are suffering from a slow, chronic form of the disease that robs them of their strength.

toxin. When the corpuscles break down at the time the germs come out into the blood, a large amount of toxin is set free in the blood at one time. This toxin poisons the cells of the body and brings on the chill and fever. There are several different kinds of malaria germs, and the chill comes every day, every other day, or every third day, according to the length of time it takes for the germs to become full-grown and break out of the corpuscle. In their growth the malaria germs destroy great numbers of red blood corpuscles, and the loss of these millions of corpuscles, as well as the poisoning of the cells by the toxin, injures the body.

How the malaria germ gets into the body. The malaria germ grows in a certain kind of mosquito (page 112) as well as in man, and it gets into our bodies from the bites of these mosquitoes. When the mosquito feeds on man, it thrusts its proboscis (bill) down through the skin and sucks out the blood. When a mosquito draws blood from a person who has malaria, it takes malaria germs into its stomach with the blood. These germs pass into the walls of the mosquito's stomach and multiply in little sacs on the outside of the stomach walls. The sacs then burst, and great numbers of the germs pass through the mosquito's body to the salivary glands. The germs appear in the saliva in about ten days from the time when they were first taken into the stomach.

FIG. 71. The stomach of a mosquito that is infected with malaria. The malaria germs grow in the sacs on the mosquito's stomach.

Now the opening in the proboscis of the mosquito is too small to allow the blood corpuscles to pass up

through it, and when the mosquito bites it injects saliva into the wound.[1] The saliva breaks up and dissolves the corpuscles, and the mosquito is then able to draw out the blood. If the malarial germs are in the salivary

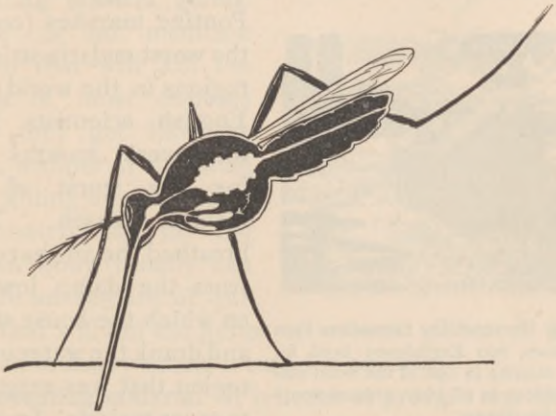


FIG. 72. Diagram of a mosquito's body. The malaria germs pass from the stomach to the salivary glands. Then they are injected through the proboscis into the persons whom the mosquito bites.

glands of the mosquito, they will, of course, be injected into the wound with the saliva. Unless the body is able to destroy them, the germs then enter the red corpuscles, and in about a week from the time the man was bitten the disease appears.

Malaria spread only by mosquitoes. It is a common idea that malaria is caused by drinking impure water or by "miasmas," or poisonous vapors, from swamps or damp ground. This idea is not correct. In Italy many

[1] It is the poisonous saliva of the mosquito that causes the itching and swelling that follow a mosquito bite.

experiments have been made, during which persons drank water from the worst malarial marshes in Italy and Sicily, and inhaled the air of the marshes. Not a single case of malaria ever followed these experiments. Near Rome, in a hut that stood in the very midst of the Pontine marshes (one of the worst malaria-stricken regions in the world) two English scientists lived for several months during the worst of the malaria season. They breathed the air that came from the damp lowland on which the house stood, and drank the water of the region that was supposed to cause malaria. In every way they lived as the people about them lived, except that in the evenings they retired to their carefully screened hut before the mosquitoes came out, and stayed behind their screens until the sun was up and the mosquitoes had retired. These men had no symptoms whatever of malaria, although the people all about them were suffering from the disease.

FIG. 73. By screening themselves from mosquitoes, two Englishmen lived for several months in one of the worst malarial regions in all Italy, without symptoms of the disease.

At the same time mosquitoes were caught in Italy, and, after they had been allowed to bite a malaria patient, were sent to London. There a physician who lived in England and who had never had malaria allowed them to bite him. In a short time he developed a case of Italian malaria and the germs were found to be abundant in his blood. These and a large number of other

similar experiments leave no room to doubt that it is by the bite of the mosquito and not by water or by damp air that the malaria germ enters the body.

FIG. 74. Germs of malaria were sent from Italy to England *in a mosquito*, and a physician who was bitten by the mosquito developed malaria.

Killing malaria germs. There is no medicine known that will kill the germs of most diseases after they get into the body, without at the same time killing our own cells. Fortunately for us, the human body usually can endure an amount of quinine that will kill the germs of malaria. There is therefore, in ordinary cases, a cure for malaria.

Preventing malaria. It is better to prevent any disease than to try to cure it, and it is better to prevent malaria than to try to kill the germs after they get into the body. The following are the best ways of preventing the spread of malaria: —

Screening malarial patients from mosquitoes. Mosquitoes that have not bitten persons who have malaria are free from the germs, and cannot spread the disease. But it has been found that in a house where there is a malaria patient the mosquitoes are usually infected and are able to give the disease to others. In regions where there is only an occasional case of malaria, or where only a few persons are living close together (as in a country farmhouse), much can be done to check the spread of malaria by keeping patients under mosquito nets until the germs disappear from the blood (page 203).

Avoiding unnecessary exposure to mosquitoes. Persons living in malarial regions should keep their houses carefully screened, and should sleep under mosquito nets during the mosquito season. They should visit houses that contain infected mosquitoes only in the middle of the day. They should remain indoors in the morning and evening, when mosquitoes are active, and on cloudy days they should keep away from woods and swamps where mosquitoes are flying. Care should always be taken in selecting places for camping and fishing trips, for one night spent among mosquitoes may start an attack of malaria that will last for months.

Destroying mosquitoes. In towns and around country houses that are at all favorably located, mosquitoes may be destroyed by removing their breeding places. So well do we understand how to do this that there is now little reason why one who does not live in a swampy region should have malaria. The best ways of destroying mosquitoes will be discussed in the next chapter.

The use of quinine. Malaria is very prevalent in many parts of the United States, and in these regions thousands of the inhabitants are constantly suffering from it. In Italy the government has had great success in preventing the spread of this disease by causing all the people who are exposed to infection to take enough quinine during the mosquito season to kill any germs that may get into the blood. It is certainly the part of wisdom for any one who is exposed to malaria to use quinine as a preventive, and if all the people in the malarial parts of our country would do this, a great burden would at once be lifted from what ought to be the richest agricultural portion of the land.

YELLOW FEVER

The germ of yellow fever has not been discovered (page 194). It is known, however, that the disease is spread only by a mosquito of a certain kind (Fig. 81). By screening yellow fever patients, by quarantining, by killing infected mosquitoes in houses where the disease has appeared, and by removing the breeding places of mosquitoes, the disease can be controlled. In our own country it will never again be allowed to spread.

FIG. 75. Dr. Walter Reed. On the tablet marking his grave is the inscription: "He gave to man control over that dreadful scourge, yellow fever."

POINTS TO BE REMEMBERED

1. Because of the great number of persons who are attacked by it, malaria is a very important disease.
2. The malaria germs grow in the red blood corpuscles.
3. They break forth from the corpuscles at the time of the chill.
4. The malaria germ is carried only by one kind of mosquito.
5. The malaria germ is one of the very few germs that may be killed with medicine after it gets into the body.
6. Malaria may be prevented by screening malaria patients, by avoiding exposure to mosquitoes, by destroying mosquitoes, and by the use of quinine.
7. Yellow fever is contracted only from the bite of a mosquito.

CHAPTER TWENTY-FOUR

MOSQUITOES

THE mosquito, more than any other one agency, has driven man from the warmer and more fertile portions of the earth to the colder and more barren regions. It carries not only the germs of malaria and yellow fever, but also the germs of dengue, or "break-bone" fever, and a small worm (*Filaria*) that lives in the blood and causes an enormous swelling (*elephantiasis*) of the limbs or other parts of the body. The two latter diseases are common in the tropics and both are found to a certain extent in some of our southern states. The germs of several diseases of man not found in our country, and of certain diseases of birds, also are carried by mosquitoes. Where it is possible to do so, the best way to end all these diseases is to destroy the mosquitoes. To work at this intelligently it is necessary first to know the life history and the habits of the mosquito.

FIG. 76. *A* is a raft of mosquito eggs; *B* is a single egg.

Life history of the mosquito. The mosquito lays its eggs on water. In about a day the egg hatches into a *larva* (commonly called a *wiggler* or *wiggle-tail*) that swims about actively in the water. The larva takes in air through a breathing tube, which it thrusts out through the surface of the water to the air, as shown in Figure 77. In from seven to fourteen days the larva changes its form. The head and the fore part of the body become much heavier, and the breathing tubes shift to the back of the body. In this stage it is called a *pupa* (commonly called a *tumbler*, because, instead of wriggling as it

swims, it tumbles over and over). In from two to five days — ten to twenty days from the time the egg was laid — the pupa splits down the back, and the adult mosquito comes out and flies away.

In the larva and pupa stages, mosquitoes feed on small plants and animals that are in the water. In the adult form, they live chiefly by sucking the juices from plants, but they eagerly attack animals and suck the blood from them when there is an opportunity to do so. How long a mosquito naturally lives in the adult form is

FIG. 77. *A* is a mosquito larva; *B* is a pupa; *C* is an adult mosquito coming out of an old pupa.

not known, but one has been kept for seventy-six days, and considerable numbers of them live through the winter, hidden away in crevices and cracks. The young and the eggs of the mosquito are not killed by being frozen, and mosquitoes often come out in the spring from eggs or larvæ that have lived through the winter.

Anopheles. The kind of mosquito that carries the germ of malaria is called *Anopheles* (a-nŏf′-ĕ-lēz). It is

an almost silent mosquito, that does most of its biting in the early part of the night and early in the morning. It can readily be distinguished from other mosquitoes by the black spots on its wings, and by its habit of elevating the back part of the body, or standing up on its head, when resting and biting. Other mosquitoes

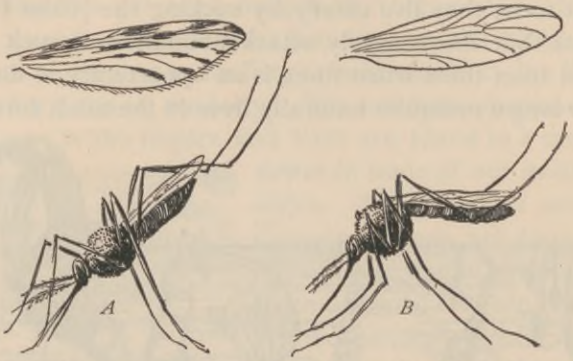


FIG. 78. *A* is the Anopheles mosquito (the mosquito that carries malaria), showing its position while resting, and the spots on its wings. *B* shows the common mosquito (Culex).

are often carried considerable distances by the wind,[1] but the Anopheles has a habit of clinging to weeds, shrubs, and bushes when the wind blows, and is not often found far (seldom more than a few hundred yards) from the place where it is hatched. The mosquitoes that give people malaria are usually[2] raised by those same people, or by their neighbors.

[1] There are some mosquitoes that breed in salt marshes and travel for miles. These rarely enter houses, and they do not carry malaria.

[2] The yellow fever mosquito is a domestic mosquito and breeds almost entirely in water about houses. The Anopheles, on the other hand, is a half-wild mosquito, and likes best to breed in the fields and woods, in ponds, small streams, and ditches.

Destroying the breeding places of mosquitoes. The first thing in the fight with mosquitoes is to deprive them of breeding places near human dwellings. An old fruit can may catch and hold enough rain water to breed a large number of mosquitoes; in the course of a summer, an almost unlimited number[1] can come from a water barrel or an open cistern; and an undrained ditch by the roadside may supply enough mosquitoes to torment and infect with malaria all the people in the vicinity.

FIG. 79. The gutter over this doorway became stopped up with leaves, and in the water that stood there, hundreds of mosquitoes were hatching. (*After photograph by the Richmond Board of Health.*)

Old cans and pans should be cleared away; water barrels, tanks, and cisterns should be screened so that the mosquitoes cannot get to them to lay their eggs; sagging eave troughs should be braced up so that no water will stand in them, for in an eave trough the larvæ may start in a very small quantity of water and then be washed down into the cistern, where they will complete their development. All pools and puddles about houses should be drained; and wells must be watched and if necessary covered, for sometimes the larvæ are found in wells. Weeds and shrubbery in which the mosquitoes can find a dark, cool place to hide during the hot part of the day, or when the wind blows, should be cut

[1] Nineteen thousand eggs and young mosquitoes have been found in a rain barrel at one time.

down. As long as mosquitoes are found about the house, the work should be continued, for if all breeding places near houses are removed, Anopheles mosquitoes and generally all other mosquitoes will disappear. The work of destroying mosquitoes in cities and towns must be taken up by public officials who have authority to compel every one to remove the breeding places on his premises.

Killing mosquito larvæ with kerosene. When pools of water cannot be drained, it is an easy matter to kill all

FIG. 80. This house was so infested with mosquitoes that the owner was about to sell it at a sacrifice, when he learned from a health official that a half-hour spent in draining the ditch or in sprinkling it with kerosene would free his family from annoyance and the danger of disease.

young mosquitoes in them by pouring a little kerosene on the water. This forms a film over the water, shutting the larvæ off from the air, and killing them in a few minutes. If the kerosene is washed away by rains, it must be renewed within ten days, for this is about the time it takes a mosquito egg to grow into a mosquito. Minnows, goldfish, and other small fish feed on the

mosquito larvæ, so by introducing these into a pond, the number of mosquitoes that breed there may be greatly lessened.

Killing adult mosquitoes. After mosquitoes have been allowed to hatch and scatter themselves, it is hard to get rid of them, but when mosquitoes in a house are known to be infected with yellow fever or malaria, it is very important to kill them at once. This is usually done by burning sulfur in the rooms that contain the mosquitoes.[1] In fighting diseases that are spread by mosquitoes, the importance of screening sick persons who may infect the mosquitoes with germs must not be forgotten. Where mosquitoes are plentiful, often the only way by which an individual can protect himself is to screen his house and bed and stay indoors when the mosquitoes are abroad.

FIG. 81. The yellow fever mosquito (Stegomyia). This mosquito has light bands around the body and on the legs. It breeds near houses and does not fly far from where it is hatched.

Communities that have successfully fought mosquitoes. It is a very easy matter, and not at all expensive, to banish mosquitoes almost completely from a town near which there are no extensive natural breeding places.

[1] The fumes of burning sulfur kill flies, fleas, and bedbugs, as well as mosquitoes, but they destroy the color in carpets and other cloth articles, and blacken the gilt on picture frames, book covers, and furniture. Burning insect powder (*pyrethrum*) will stupefy flies and mosquitoes so that they can be swept up and burned.

Even in regions where there are large marshes and many streams and ponds, by systematic work communities can free themselves from mosquitoes. This has been done in Havana and New Orleans during yellow fever epidemics, and the inhabitants of the North Shore of Long Island and of certain towns in New Jersey, where the mosquitoes were formerly so abundant that they were a veritable pest, have now conquered their winged enemies. In this book there is not space to tell of the work that has been done in these places, but from the Department of Agriculture at Washington, D.C., and from state and city boards of health, bulletins can be obtained that give many interesting facts about mosquitoes, with directions for fighting them.

POINTS TO BE REMEMBERED

1. Mosquitoes carry malaria and yellow fever.
2. In ten days the mosquito can pass through the larva and pupa stages and come out in the adult form.
3. The mosquito that carries malaria has spotted wings, and when resting stands upon its head.
4. The mosquitoes that carry malaria and yellow fever spend their lives near where they hatch.
5. A town or a country house can be freed of mosquitoes by removing the breeding places.
6. Public health officials are absolutely necessary in fighting mosquitoes.
7. Mosquito larvæ may easily be killed with kerosene.
8. When the mosquitoes in a house are infected with disease germs, they may be killed by burning sulfur in the house.
9. Many towns and communities, some of them very unfavorably located, have freed themselves from mosquitoes.

CHAPTER TWENTY-FIVE

SMALLPOX

Up to about a hundred years ago, smallpox was one of the most terrible diseases known to man. It is estimated that in the eighteenth century it killed 60,000,000 people, and that 6,000,000 of the 12,000,000 inhabitants of Mexico died from it when it was introduced into that country by the Spaniards. In Europe nearly every one sooner or later had to undergo an attack of the disease. "It was always present, filling the churchyards with corpses, tormenting with constant fears all it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover." Fortunately for us, a method of preventing smallpox has been discovered, and in civilized countries it has now become a rare disease.

The germ of smallpox. Smallpox is caused by a small germ that lives in the skin and in the lining of the mouth, throat, and nose, and sometimes in the trachea and esophagus (page 194). The germs cause pustules or sores to form in the deeper layers of the skin. These break through to the surface of the skin, and in the later stages of the disease the matter from these pustules dries as scabs over the body. The incubation period of smallpox is from seven to twenty-one days.

Some races of smallpox germs are weak and produce a type of the disease so mild that it is often mistaken for chicken pox. Other races are very virulent and cause smallpox of so malignant a type that numbers of the victims die, and many of those who recover lose their

sight. In this disease, as in diphtheria and other infectious diseases, it would seem that weak races of germs may become strong, and that a mild type of the disease may at any time change to the malignant form. It is important, therefore, that mild cases of smallpox should be quarantined and not pronounced chicken pox; for from a mild case of the disease, germs may be spread abroad that will bring many persons to their graves.

FIG. 82. Bodies thought to be the germs of smallpox in the cells of the skin. The small, dark bodies with the clear spaces about them are the supposed germs.

How smallpox germs are spread. The germs of smallpox are abundant in the matter on the skin of a smallpox patient, they are in the discharges from the mouth and nose, and are found in great numbers in the scales that come from the skin during recovery from the disease. These germs may be scattered about by the patient's coughing or sneezing, they are left on anything he touches, they may be carried on the feet of flies, and it is possible that they are at times blown for short distances through the air in the light, dry scales that come from the skin. Smallpox germs may be dried for months without being killed, and on clothing, books, letters, old rags, and many other things, they are sometimes carried about. It is therefore very important that a smallpox patient should be quarantined, and that everything about him should be thoroughly disinfected (page 159).

VACCINATION

To very few human beings has nature given white corpuscles and germicidal substances that can resist the smallpox germ. Up to the time vaccination began to be practised, more than 95 per cent of all persons suffered from it, and people considered it a disease that every one must have, just as we look on chicken pox and mumps as diseases that most of us will probably have to go through with sooner or later. About the year 1800 vaccination began to be practised, and smallpox at once began to decline. Now vaccination is more or less compulsory in every civilized country in the world. Where it is thoroughly carried out, smallpox has almost ceased to exist, but where the people are not vaccinated, or a considerable number of them are not vaccinated, it is still impossible to prevent the spread of the disease. This is because mild cases escape quarantine, because the germ withstands drying for a considerable period of time, and because it is so powerful a germ that if 100 unvaccinated persons are exposed to it, from 95 to 98 of them will be attacked by the disease.

FIG. 83. Edward Jenner, who in 1797 discovered vaccination, the greatest medical discovery the world has ever known.

Vaccination an almost perfect protection against smallpox. In 1870–1871, during the Franco-Prussian War, all

German soldiers were vaccinated, while only a part of the French soldiers were vaccinated. In the French army there were 6000 deaths from smallpox, and the French wounded suffered greatly from the disease. In the German army there were only 278 deaths from smallpox, and among the German wounded who lay in the same tents with the French wounded, not a single case occurred. At the same time the German soldiers suffered as much as the French, or even more, from typhoid fever, dysentery, and other germ diseases.[1]

FIG. 84. Dr. Benjamin Waterhouse, who introduced vaccination into America in 1800. He insisted on the use of pure virus and keeping the wound clean.

From time to time certain persons in England have opposed vaccination, and for a while the center of this opposition was in Gloucester. In 1895 that city had a population of 42,000, among whom were a very considerable number of persons who had not been vaccinated. In the last weeks of 1895 smallpox broke out, and a great epidemic of 1979 cases and 439 deaths occurred. An attempt was made to control the disease by quarantining and careful disinfection, but this was an entire failure. In January, 1896, there were 28 cases, in February 146 cases, in March 644 cases,

[1] There were 73,396 cases of typhoid fever and 8709 deaths from typhoid in the German army during the Franco-Prussian War. This shows that it was not superior sanitation or medical attention, but vaccination, that protected the German soldiers from smallpox.

and in April 744 cases. By the end of April more than 36,000 of the inhabitants had been vaccinated, and Gloucester was the best vaccinated city in the world. The epidemic at once began to decline, and by August it had disappeared.

In Philadelphia there was a considerable epidemic of smallpox during the years 1901–1904. During this period more than 3500 cases were admitted to the Municipal Hospital, and of these 3500 cases not one had been successfully vaccinated within five years. During this time many physicians and nurses were employed in the hospital, and more than 700 medical students were taken to visit the patients. Not one of all these persons contracted smallpox except one student who was opposed to vaccination and untruthfully said that he had been vaccinated. At one time it was necessary to enlarge the hospital, and fifty or sixty workmen were employed to do this. All of them were vaccinated except two, and these two and no others took the disease. Again it was necessary to enlarge the hospital, and another squad of workmen was employed. For some reason two of these were not vaccinated. These two were attacked by smallpox, while again all the workmen who had been vacci-

FIG. 85. Thomas Jefferson, one of the most broad-minded and far-seeing Americans of his time. In 1806, writing to Edward Jenner, he said, "Future nations will know by history only that the loathsome smallpox has existed and by you has been extirpated."

nated escaped. Thus within the hospital all of the hundreds of persons who had been vaccinated escaped the disease, and all five of those who had not been vaccinated contracted it.

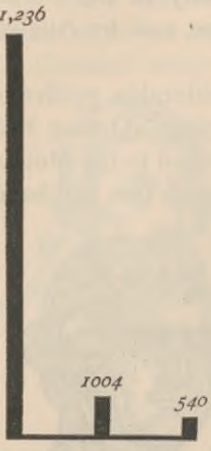


FIG. 86. Diagram showing how vaccination protects against smallpox. During 1912, 1913, and 1914, health officials in the United States secured the vaccination histories of 12,880 smallpox patients. Of these, 11,236 (more than 87 per cent) had never been successfully vaccinated; 1104 (slightly more than 8 per cent) had been vaccinated more than 7 years before the attack; and only 540 (a little over 4 per cent) had been vaccinated within the last 7 years before the attack. (Data from United States *Public Health Report* of October 2, 1914.)

Many pages could be filled with similar statistics showing that vaccination almost surely prevents smallpox. Yet many persons seem never to have heard of these facts, for there are still in our country societies that actively oppose vaccination. Some people think that among those who do not believe in vaccination are some of the prominent physicians of the country. This is a great error, for hardly any of the physicians who oppose vaccination are even graduates of medical colleges, and none of them have any prominence in their profession. The leaders of medicine for the last hundred years have believed in vaccination and have practised it, and today there is not a prominent medical man in America who is opposed to it. On this point the Medical Society of the State of Pennsylvania says: "We know of *no physician of eminence in this country* who is not a believer in — nay, even an ardent advocate of — vaccination."

How vaccination protects against smallpox. The germ of smallpox flourishes in man. It grows in cattle also, causing the disease called *cowpox*. After growing in the cow, this germ seems to be weakened and changed so that it grows feebly in man and has only a slight power of producing disease.

In vaccination, germs from a cow are put into the human body. Here they grow and begin to produce the mild inflammation that follows vaccination. The body now works up the germicidal substance for these germs, and because the germs are weak, the body is able to kill them out before they can multiply to any extent. After this is done, the germicidal substance remains in the blood, and if smallpox germs at any time get into the body, the germicidal substance is there ready to kill them and keep the disease from getting a start. A person who has been successfully vaccinated is therefore in much the same condition as a person who has had a light attack of smallpox, for he has in his blood a substance that will kill any smallpox germs that may get into his body.

How long vaccination protects against smallpox. After vaccination, the germicidal substance in the blood becomes weaker and weaker, but seldom disappears entirely. Just when it becomes so weak that it is necessary to be vaccinated again, it is impossible to say. Sometimes it is fairly strong after seven, eight, nine, or ten years. In a very few persons it disappears so rapidly that in nine months it fails to protect against smallpox. The safest way is to be vaccinated every few years, and when there is danger of being exposed to smallpox, to be vaccinated again if more than nine months have

passed since the last vaccination. There can be no mistake in this, for if the germicidal substance is still strong in the blood, all the germs put in by vaccination will be killed and the vaccination will not take. If the vaccination does take, it is a sure sign that the germicidal power of the body is beginning to run low and that another vaccination is needed.

Why every one should be vaccinated. *Every one should be vaccinated to protect himself.* We never know when the smallpox germ may come to us from the seats of a car, from a letter, from the clothes of some person, or in any one of many other ways. If smallpox germs do get to a person who has been successfully vaccinated, that person will in all probability kill the germs and suffer no harm. If he has not been vaccinated, he will probably suffer from an attack of smallpox, with a considerable risk of losing his life. Even if he recovers, he will be fortunate if he is not more or less scarred and pitted for life.

Every one should be vaccinated to protect others. Persons who have smallpox cause expensive quarantine, they interfere with business and with schools, and by scattering abroad smallpox germs they endanger the lives of others. A person who refuses or neglects to be vaccinated and then takes smallpox, makes a public nuisance of himself, and it is neither fair nor right to be a nuisance to one's friends and neighbors. In 1885 *one* man carried smallpox to Montreal and started an epidemic that cost over three thousand lives.

Little danger in vaccination. Vaccination causes only a small sore, and there is practically no danger from it when it is properly done. How little danger there really is from it is shown by the fact that 3,709,187

persons were vaccinated by government officials in the Philippine Islands, during the years 1907–1908, without a single death. The greatly swollen arms and running sores that sometimes follow vaccination are caused by pus-forming bacteria and are not a true part of vaccina-

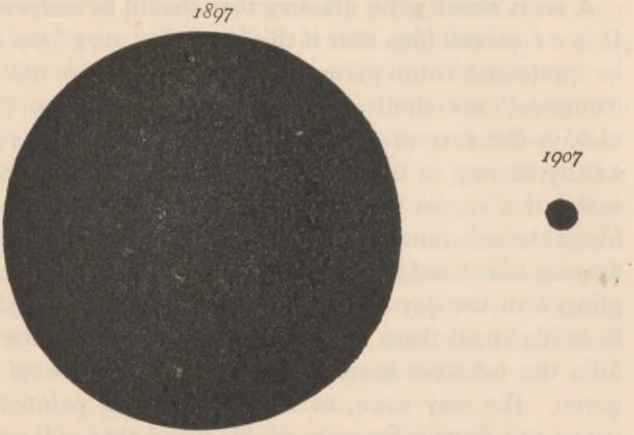


FIG. 87. In the Philippine Islands, before the American occupation, only a small part of the inhabitants were vaccinated. In 1897, about 40,000 people died from smallpox. In 1907, there were 304 deaths from this disease in all the islands. It is vaccination that has caused this decrease, for in most parts of the Philippines there is no quarantine or disinfection of a kind that would have any effect in controlling smallpox.

tion at all. The pus-forming germs usually get into the wound in impure virus, from infected instruments (as from a lancet that has been used in opening a boil), from an unclean skin, or from dirt that gets into the wound. Only pure virus should be used,[1] the skin and instruments should be clean, and the wound (like any other wound) should be protected from pus-forming and tetanus germs.

[1] Only virus that has been carefully prepared and sealed in glass tubes should be used.

When one gets a great sore on the arm, it is not possible to tell whether the vaccination virus is working or not, and many persons who think they have been successfully vaccinated have only had a growth of pus-forming bacteria in their arms.

A point about germ diseases that should be understood. It is a common idea that if the blood is "pure" we shall be protected from germ diseases, and if the blood is "impure" we shall suffer from these diseases. This idea is not correct. A person's blood may be as pure as any flowing in the veins of man, and yet that person will fall a victim to smallpox germs if he lacks in his blood the substance that kills those germs. His muscles may be like bands of steel and his nerves may be tingling with the joy and vigor of perfect health, and yet if in his blood there is not the particular substance that kills the tubercle bacillus, he had best beware of that germ. He may even, as we have already pointed out (page 13), have substances in his blood that will enable him to kill some kinds of germs and yet may fall an easy victim to germs of another kind. Resistance to germs is, therefore, not a question of pure blood, but a question of having in the blood particular substances that will kill particular germs.

In former chapters we have advised you to keep up the health of the body so that it will be able to kill germs, and it is true as a general statement that when the body is in health it is able to manufacture more of the substances that kill germs than it can manufacture when it is weak. You should know, however, that for reasons that are not understood, the body sometimes suddenly loses its power to resist germs even when it seems to be

in health. You should also understand that before smallpox germs nearly every one goes down as the wheat goes down before the sickle, and that the only way you can make yourself safe from this disease is to get your body, beforehand, to work up a supply of the germicidal substance for the smallpox germ. Therefore, when any one begins to tell you that health consists in keeping the blood pure, and that vaccination is contrary to the principles of health because it introduces into the body matter from a cow that will cause the blood to be impure — when any one talks to you after this fashion, pay no attention at all to him. For though your blood were as pure as the crystal water from a snow-capped mountain peak, it would not kill the smallpox germ unless it contained the germicidal substance for that germ. It is strong blood, and not pure blood, that we need in our battle with the germs.

POINTS TO BE REMEMBERED

1. Until vaccination was discovered, smallpox was the most dreaded of all diseases.
2. The smallpox germ can withstand drying and is easily spread.
3. Vaccination almost surely protects against smallpox.
4. In vaccination a weak race of smallpox germs from cattle is put into the body.
5. The body produces a substance to kill these germs.
6. This germicidal substance then remains in the blood.
7. Any danger there may be in vaccination comes from bacteria that get into the wound and not from the vaccination itself.
8. It is best to be revaccinated every few years, and whenever one has been exposed to smallpox.
9. Pure blood may not protect us from germs.

CHAPTER TWENTY-SIX

OTHER PROTOZOAN DISEASES

In the tropics there are many protozoan diseases that are unknown in our country. Among these diseases is the slow and surely fatal *sleeping sickness* of Africa, which is estimated to have killed a half million people between the years 1896 and 1906. It is communicated to man by the bite of a fly, and in some villages from 30 to 50 per cent of the people are affected.

Another protozoan disease of hot countries (a severe malaria-like fever called *kala-azar*) is carried by the bedbug and probably also by the flea. Chronic dysentery is another very important protozoan disease, and there are a number of other diseases that are probably caused by protozoa, although the germs that cause them are unknown. In this chapter we shall study certain of these diseases that are of importance in the United States.

RABIES (HYDROPHOBIA)

Rabies is caused by a very small germ that is believed to be a protozoön. It grows especially in the brain and spinal cord and gets into the body usually from the bites of dogs or cats. In man the incubation period is never shorter than fourteen days; usually it is five or six weeks, and it may be a year. The germs are in the saliva three days (possibly eight days) before the animal shows symptoms of the disease. In their wild state, wolves, foxes, coyotes, and skunks may suffer from the disease.

Preventing rabies. Practically all the rabies in our country comes from the bites of dogs, and by keep-

ing dogs properly muzzled it is possible to stamp out the disease entirely, as has been done in several European countries.[1] It is a mistake to think that rabies develops in dogs because of hot weather or lack of water. The dog gets the germ into its body from the bite of another dog, and dogs may suffer from the disease at any time of the year. A rabid animal has a habit of scratching at its mouth to remove the tough saliva, and a wound from the claws of such an animal is therefore dangerous.

FIG. 88. If all the dogs in our country could be muzzled for a few years, rabies would disappear. The dogs could then be unmuzzled without danger of the disease to man or beast.

The Pasteur treatment. There is no cure for rabies after the disease develops, but a preventive treatment has been discovered by a great Frenchman named

[1] The following statistics give the number of deaths from rabies in England and Wales for each year, from 1887 to 1907, and show clearly how muzzling dogs checks the spread of the disease: —

Year	*Deaths*
1887	29
1888	14
1889	30
Muzzling enforced	
1890	8
1891	7
1892	6
Opposition to muzzling; ordinance not enforced	
1893	4
1894	13
1895	20
Muzzling again enforced	
Year	*Deaths*
1896	8
1897	6
1898	2
1899	0
1900	0
1901	0
1902	2
1903	0
1904	0
1905	0
1906	0
1907	0

Louis Pasteur. This treatment is founded on the same principles as vaccination. Weak germs are put into the body, and by killing these weak germs the germicidal power of the body is increased. The body then goes on and not only kills the weak germs that have been put into it during the treatment, but kills also the germs that are in the wound made by the rabid animal. Thus the disease is prevented. The Pasteur treatment is successful in nearly all cases in which it can be commenced in time. Where the materials for this treatment can be delivered within thirty-six hours after they are shipped, they can be sent by mail and the treatment can be given to the patient by his home physician.[1]

Treatment of wounds made by rabid animals. A very great safeguard against rabies is to treat promptly all wounds made by the teeth of animals with something that will kill the germs in the wound. Any disinfectant (page 159) is useful, but burning with nitric acid is the most effective remedy. This should be done by a physician, to make sure that it is thoroughly done, and to guard against too great injury to the flesh by the acid. The best way is to wash the wound at once with

[1] There was formerly a curious superstition that certain stones, called "madstones," would prevent rabies. Some person in the community would possess one of these stones, and when any one was bitten by a rabid dog, the stone would be applied to the wound to "draw out the poison." It need hardly be said that madstones are of no use in preventing rabies, and that intelligent persons long ago gave up their use. It is perhaps well to know that in several instances rabies is believed to have been caused by the use of a madstone. The stone became infected with the germs from the blood and saliva in wounds to which it had been applied, and then, when placed on a wound made by a dog that did not have rabies, the germs were introduced into the wound and the disease was produced.

turpentine, carbolic acid, bichlorid of mercury, or some other disinfectant, and then go to a physician. Treatment even after twenty-four hours is useful. It is easier for the body to kill a few germs than a large number, and a disinfection of the wound that kills even a part of the germs is a great help. An animal that has bitten any one should not be killed, but should be shut up until it is known whether or not it has rabies. If the animal remains in health for nine or ten days, there will be no occasion for worry. If it shows symptoms of the disease, it should be killed without injuring the brain, and the head should be sent to a Pasteur Institute or to a bacteriological laboratory. There the brain can be examined for the germs of rabies, and if they are found, it will be certainly known that the treatment should be begun at once.

FIG. 89. The germ of dysentery. The dark bodies in the germ are red blood corpuscles on which the germ feeds.

CHRONIC DYSENTERY

Acute dysentery (page 81) is caused by a bacillus that is closely related to the typhoid germ. There is a chronic form of dysentery, however, that is caused by a protozoön. This germ is much larger than most disease germs, and in many ways it resembles a large white blood corpuscle. Its life outside the body is not well known, but there is abundant evidence that the disease is usually contracted by drinking impure water. Infection seems to come also, at times, from eating raw vegetables that have been grown in polluted soil. Chronic dysentery is

more common in the southern than in the northern states, but cases of it occur in all parts of the country.[1]

MEASLES

Measles is a very infectious disease even in the early stages. The breaking out is not only on the skin but also in the eyes, throat, and air passages, and the germs are in the secretions from these parts. During an attack of measles the eyes should be rested, shaded from light, and bathed in boracic acid or other disinfectant several times a day, and the patient should have careful nursing and be protected from the germs of colds, influenza, pneumonia, and tuberculosis; for, more than almost any other disease, measles weakens the resistance of the body to all germs, and many cases of bronchitis, pneumonia, and consumption follow an attack of this disease. The incubation period is very regularly from nine to eleven days, and the eruption usually appears the fourteenth day. This disease is much more dangerous to children than to older persons, and the great majority of deaths from measles is among children under five years of age.

Measles is a far more serious disease than is generally supposed, and it should be strictly quarantined (page 207). A patient is dangerous as long as the discharges from the eyes and nose continue, usually for a period of about three weeks from the breaking out of the rash. In a house the germs die out in about two weeks. German

[1] Dysentery germs are abundant in the discharges from the bowels of any one who is sick with the disease. It is therefore very important that these discharges should be carefully destroyed (page 161), so that the germs may not be carried about by flies or in other ways.

measles is supposed to be a different disease from ordinary measles, and one that is less severe.

CHICKEN POX

Chicken pox is usually a mild disease and seldom attacks any one but children. It is of importance mainly because mild cases of smallpox are often mistaken for it. The incubation period is from thirteen to eighteen or nineteen days.

SCARLET FEVER

The germ of scarlet fever has not been discovered, but it is known that the discharges from the throat, nose, eyes, and ears are infectious, and the patient is dangerous as long as these discharges continue. The germs withstand considerable drying, but the scales from the skin are not infectious and the disease is not air-borne, as was formerly supposed. It is a difficult disease to control, because there are mild cases ("missed cases") of it that are not recognized and quarantined. The incubation period is from two to five days, and the patient is usually quarantined about fifty days. It attacks children especially, and a person usually has the disease but once.

Scarlet fever is a very dangerous disease because there often goes with it a severe attack of the pus-forming bacteria on the kidneys, ears, eyes, throat, or other part of the body, and it is not uncommon for it to leave its victims deaf or blind, or in some way injured for life. It should, therefore, be carefully quarantined, and a close watch kept for the mild cases from which epidemics often spring (see footnote, page 205).

PROTOZOAN DISEASES OF ANIMALS

Texas fever, or "tick fever," a very severe malaria-like disease of cattle in the southern part of the United States, is due to a protozoön in the blood. This germ is carried from one animal to another by a kind of tick. Nagana is an African disease of animals, the germ of which is carried by a fly. This disease kills all horses and cattle over a large area in central Africa, and makes travel and agriculture very difficult in that region. Surra is a protozoan disease spread by the bites of flies that is fatal to great numbers of horses and cattle in India and other parts of southern Asia, in the East Indies, and in the Philippines. Protozoa are found also in the blood of rats; and birds, turtles, frogs, and many other animals are infected with them.

POINTS TO BE REMEMBERED

1. Rabies is due to a very small germ that attacks especially the brain and the spinal cord.
2. Almost all the rabies in our country comes from dogs, and the disease can be stamped out by properly muzzling dogs.
3. The Pasteur treatment will usually prevent rabies from developing, if treatment is begun in time.
4. A wound made by the teeth of an animal should be carefully disinfected.
5. Chronic dysentery is a protozoan disease and usually is contracted from polluted water.
6. Measles and scarlet fever are dangerous diseases that should be strictly quarantined.
7. Many diseases of animals are caused by protozoa.

CHAPTER TWENTY-SEVEN

INTESTINAL WORMS

INTESTINAL worms are in no sense germs, for their bodies are composed of many cells, and some of them are animals of considerable size. Yet we shall briefly discuss some of the more important of them, because they afflict more people than is generally known, and because by proper sanitation they can be avoided. How important this subject is may be known when it is learned that in some tropical countries almost the whole population is infected with these worms, and that in countries like Germany examinations have frequently shown that from 30 to 50 per cent of the people of a community were infected with intestinal worms of one kind or another. Extensive studies of this subject made in the United States show that intestinal worms are much more frequent in the southern states and in California than they are in the northern states.

EELWORMS

Eelworms (*Ascaris lumbricoides*) are large yellowish white worms, thicker than a lead pencil, and sometimes over a foot long. Examinations in other countries have proved that from 10 to 40 per cent of the people are infected. Eelworms are probably less frequent than this in the United States, but many people, especially children, suffer from them. The eggs develop in the soil into small worms, and it is probable that these are usually swallowed in water. The way to check the spread of these worms is to prevent the pollution of the soil, for the eggs that cause the trouble are spread only by infected human beings.

PINWORMS

The pinworm (*Oxyuris*) is a small white worm that grows mainly in the lower part of the large intestine. The disease is most common in children. The eggs are often on the hands of infected children; they may get into drinking water; or children, by playing in polluted soil, may get the eggs on the hands and into the mouth. Children that are infected should be treated, so that they may not infect others, and the soil about wells and houses should be kept free from pollution.

WHIPWORMS

The whipworm (*Trichuris*) is a slender white worm nearly two inches in length. The eggs get into the body by being swallowed. In some parts of Europe from 10 to 30 per cent of the people are infected, and it is known that the disease is not at all uncommon in the United States.

HOOKWORMS

The hookworm (*Necator*) is white in color, of the thickness of a moderate sized sewing thread, and about one third of an inch in length. This worm is found in the warmer parts of the whole earth, Africa, India, China, Porto Rico, Guiana, Colombia, the Philippines, and many other places being heavily infected. Of more than 700,000 persons examined for hookworm in the southern part of the United States, 35 per cent were found to be infected, and it is estimated that there are two million people in this region suffering from the disease. The worms live in the small intestine and feed on blood which they suck from the wall. Much blood

besides that which they use for food is lost through the wounds that they make; for they move about freely in the intestine and keep making fresh wounds in the wall. A person may carry any number of them from a very

FIGS. 90 and 91. Hookworm victims. (*After photographs by Dr. Charles W. Stiles, U. S. Public Health and Marine-Hospital Service.*)

few up to several thousands, and severe cases of the disease may end in death.

How hookworms get into the body. The eggs of hookworms pass out of the alimentary canal, and if they are allowed to get into the soil, they develop into very tiny worms. These small worms usually enter the body through the skin (causing "ground itch," "toe itch," or "dew sores"), make their way to the lungs, crawl up the trachea to the mouth, and reach the intestine by being swallowed. They may also be taken into the intestine in water, or in food that is eaten with soiled hands. The worms do not multiply in the intestine, but they are known to live for more than six years and they probably live as long as ten years. Under favorable conditions, the young have been found to live in the soil for more than five months, but both the eggs and the young worms are killed by thorough drying and by freezing.

Hookworm disease. The hookworm produces a toxin which poisons the body, and this with the loss of blood causes a marked anemia (lack of red blood corpuscles). Some of the prominent symptoms of the disease, which are especially marked in severe cases, are paleness, continued weakness, mental dullness, dry skin and hair, dull, staring eyes, swelling of the limbs and face, and in young persons a stunting of the growth. Sometimes there is an appetite for such substances as earth, ashes, paper, coffee grounds, salt, and plaster.

Where hookworm disease is most common. Hookworm disease is most common on light and sandy soils (the kind of soil on which pine trees grow). It is more common among children than among adults, because children go barefooted, and sometimes eat with unwashed hands after playing in the earth; it is more common among miners, agricultural laborers, brickmakers, and railroad laborers than among those who do not come in contact with the soil; and the disease is more severe (though not more common) in the white than in the colored race.

The prevention of hookworm disease. The eggs of hookworms get into the soil only from persons who have the disease. Away from the air, or in very wet soils, the eggs die, and *the disease can be entirely prevented by the use of closets.*[1] Great care should therefore be taken to prevent the pollution of soils about houses. To a great extent children may be saved from infection by the wearing of shoes; but keeping the soil free from

[1] Of 189,586 country homes inspected by the Rockefeller Sanitary Commission, 95,988 had no closets at all, and 87,156 others had open closets that allowed the wastes to spread freely over the soil.

pollution is the important measure in the prevention of hookworm disease (page 203).

Weakness caused by intestinal worms. Hookworm victims are too weak to work effectively, and hundreds of thousands of persons are living in poverty and ignorance because of this disease. Because these persons do not have the symptoms of ordinary sickness, it is often not realized that they are in a diseased condition, and their poverty is attributed to shiftlessness and laziness instead of to the true cause.

The sapping of the vitality of the body by these small robbers also lessens the resistance of the body to tuberculosis and other germ diseases. An instance of the truth of this statement comes from the Philippine Islands. When American officials took over from the Spaniards the great prison in Manila, there were about 4000 prisoners in it. Most of these prisoners seemed to be in fairly good health, but many of them died of diseases from which they should have recovered, and in spite of all the care of the authorities, the death rate was very high (about 70 a year for each 1000 prisoners). An examination with the microscope showed nearly all the prisoners to be infected with intestinal worms. Medicines were then given to kill the worms, and after that the death rate in the prison was little more than one sixth of what it had been before (falling to 12 a year for each 1000 prisoners). These facts show clearly that intestinal worms lower the resistance of the body to disease germs.

Preventing the spread of intestinal worms. The first great step in preventing the spread of intestinal worms is *to treat the persons who are infected with medicines to*

kill the worms. This will not only restore these persons to health, but it will stop the supply of eggs that infect others. Hookworm disease is especially easy to cure; for a few doses of a very simple remedy will entirely free a patient from the worms.

The second great step in the prevention of the spread of intestinal worms is *to build closets to receive the wastes from the alimentary canal, and to stop the pollution of the soil about houses and school grounds.* This precaution alone will not only almost entirely prevent the diseases that are caused by intestinal worms, but it will in a great measure prevent the spread of intestinal diseases that are caused by germs. It is to be remembered that many persons who themselves show no signs of ill-health may be infected with intestinal worms, and *all* soil pollution about houses should be stopped.

POINTS TO BE REMEMBERED

1. Intestinal worms are far more common than has been generally supposed.
2. The young of the eelworm develop in the soil and are swallowed in water.
3. Pinworms may be spread by the hands or by water.
4. Whipworms are swallowed in water.
5. Hookworm infection is common in our southern states.
6. The young worms get into the body either by passing through the skin or by being swallowed.
7. This disease causes much poverty and ignorance.
8. Hookworm victims fall an easy prey to other diseases.
9. The disease can be prevented by preventing soil pollution.

CHAPTER TWENTY-EIGHT

THE IMPORTANCE OF SANITATION

SUPPOSE that on a certain day in every year all the people in a village of a thousand inhabitants had to march past a bag in which there were a thousand balls, and each person had to draw a ball from the bag. Suppose that in the bag there were as many white balls as there were persons in the village who would escape all germ diseases during the next year, and as many balls of various colors as there were persons in the village who during the next year would be attacked by germ diseases. Suppose also that as many of these colored balls were marked with black crosses as there were persons in the village who in the next year would die of diseases caused by germs. In an average American village, then, there would be in the bag two or three red balls for those who were marked for tuberculosis, the same number of green balls for the victims of typhoid, perhaps eight or ten blue balls for those selected for pneumonia, and a great number of other balls of various colors for those who must suffer from some serious infectious disease, such as diphtheria, meningitis, influenza, whooping cough, measles, or scarlet fever. There would also be in the bag some six or eight balls marked with the fatal black cross, which meant that before the year was done whoever drew that ball would die because of germs.

If all the people of a town had to go through a drawing like that described above, would there not be a great fear in the heart of every one lest he or some one whom he loved should draw a fatal ball? And if some one should come to the village who could show the people what to do so that there would be only a few colored

balls and almost no balls with black crosses in the bag, would not the people help him and encourage him in every way? We are sure that they would gladly give him the money that he needed in his work, and that they would assist him as much as was in their power.

FIG. 92. Louis Pasteur. He discovered the Pasteur treatment for rabies and did more than any other one man to make clear to us the nature of germ diseases and to point out ways by which these diseases can be prevented.

The danger from germ diseases in the average American town. In the average American town the people are in the same danger from germ diseases that they would be in if they had to go through a drawing of lots like the one described above. This you can readily believe after your study of former chapters of this book. In every town a certain number of people are stricken with infectious diseases each year. Each year we hope that neither we ourselves nor any one who is dear to us will be the victims of the germs, but who they will be it is never possible to tell. Victims there will certainly be, for neither by day nor by night do our small enemies rest, and year by year they take their toll from every village in the land.

Our defenders from the germs. From the beginnings of history, man has been attacked by unseen foes, slain by hands that were invisible. In the last thirty years our enemies have been found out, their homes have been

discovered, their ambuscades have been torn down, and the paths by which they reach us have been traced out. We have now physicians and health officers who can tell us how to escape most of the germs that attack us. They have come to show us "how to arrange matters so that there will be very few colored balls and almost no balls with black crosses in the bag." Shall we work with these persons who can in great measure defend us from the germs that would attack us, or shall we refuse their aid and allow the germs to ravage and destroy, as they have done ever since man has lived upon the earth? This is the question that each community is now being asked to decide.

FIG. 93. Robert Koch. In 1876 by experimentation he proved beyond doubt that disease can be caused by a germ. He discovered the bacillus of tuberculosis and was one of the great leaders in the warfare against germs.

Sanitation. *Sanitation* comes from a Latin word (*sanitas*) that means wholeness, or health. It is the science of how to preserve the health, especially the public health. To have our premises clean and free from flies and mosquitoes, our milk and water supplies pure, and the air we breathe free from dust, is sanitary. To live among insects, dirt, and germs, to drink impure water and unclean milk, and to allow germs to be spread abroad from the bodies of persons who are diseased, is insanitary.

It is of interest to note that from the same Latin word from which *sanitation* comes, we get also our words

sanity and *saneness* (soundness of mind), and *insanity* (unsoundness of mind). *Sanity* and *sanitation* mean the same in their origin, and we might conclude that to practise sanitation is to act sanely and sensibly, while not to practise it is to act in a way that indicates either a lack of knowledge or a lack of wisdom. Certainly (since every one is anxious to escape disease) we should not be far from the mark if we spoke of a town that was clean and free from dangerous germs as a sensible, sound-minded town, and of a town in which the people lived amid dirt and germs as a foolish town. In former chapters of this book we have discussed the importance of keeping down dust, of having pure water supplies, and of destroying mosquitoes. We shall now study other measures that may be employed in making our homes and communities sanitary places in which to live.

POINTS TO BE REMEMBERED

1. Every year in every town a number of persons are attacked by disease germs.
2. Most cases of germ diseases can be prevented.
3. Physicians and health officers can tell us how to escape these diseases.
4. It is sensible to practise sanitation and, as far as possible, avoid germ diseases.

CHAPTER TWENTY-NINE

THE HOUSEFLY

THERE is a belief among some people that flies are useful because they feed on wastes. No greater mistake could be made. Flies light on and walk over all manner of unclean matter, and then spread germs and uncleanness over dishes, food, and milk vessels. They may come to our faces straight from feeding on the sputum of a consumptive or the wastes of a typhoid patient. They may fly directly from some one who has sore eyes to our hands or faces or to the very eyes of a little baby that cannot defend itself from them. There is nothing more dangerous or more unclean than to live among a swarm of flies.

Kinds of germs carried by flies. Almost any kind of germ may be carried by flies. Not only do they carry germs on their feet, but when a fly feeds on matter that contains disease germs, the germs are found in the matter that comes from its alimentary canal. In one speck left by a fly that had been captured on the face of a leper, 1115 leprosy germs were found. Tuberculosis germs and typhoid germs have also been found in fly specks, and there is no reason why a fly that walks over or feeds on matter containing the germs of any disease should not spread abroad those germs (page 192).[1]

Keeping germ-containing matter away from flies. A fly may get germs on its feet by walking on the skin of a patient who has smallpox, measles, scarlet fever, or

[1] A study of 415 flies showed them to be carrying from 550 to 6,600,000 bacteria. The average was 1,250,000. Living typhoid bacilli have been found to remain in or on the bodies of flies for 23 days, and tubercle bacilli for 15 days.

erysipelas. It may easily take up dangerous germs from an open sore or ulcer. Flies are certain to become infected if they are allowed to feed on the sputum of a

FIG. 94. This child is healthy and well, but flies may leave disease germs in his food.

consumptive, pneumonia, influenza, or diphtheria patient. The wastes from typhoid, dysentery, and cholera infantum patients must be absolutely destroyed, or flies may carry the germs all over the vicinity and may endanger

the life of every one in the neighborhood. In general, it is unsafe to have flies about any person sick with an infectious disease, for there is always danger that by lighting on his hands or face, or on some article in the room, they will take up germs.

Screening against flies. From what you already know you will realize the importance of screening against flies, of freeing our houses as much as possible from them, and of covering all food and dishes from flies. When any flies at all are in a house, a young child should aways be screened from them, for it is not right to leave a helpless little baby where it will not only be continually annoyed by flies crawling over it, but will have many different kinds of dangerous germs left on its face.

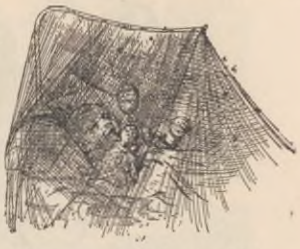


FIG. 95. A baby should be screened from flies.

Removing the breeding places of flies. By far the most effective way of dealing with flies is to remove their breeding places. The egg of the housefly is laid in manure (chiefly in horse manure, and almost entirely in fresh manure) about stables, and to some extent in dry closets, garbage, and decaying vegetable matter. In a day or less the egg hatches into a small, white, footless maggot, which in nine or ten days from the time the egg was laid changes into the adult fly.

It is estimated that three hundred flies may hatch in a cubic inch of manure, and if the breeding places of the flies are left undisturbed, they will hatch faster than it is possible to kill them. It is a simple matter, how-

ever, to stop their increase by removing, once a week, all matter in which they breed, burying it, or spreading it on the fields where it will dry and the eggs and young of the fly will be killed.[1] They can also be kept from breeding in manure by covering it with lime, or sprinkling it with borax or a solution of hellebore in water.

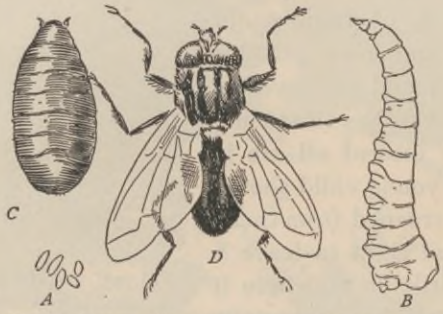


FIG. 96. The life history of the fly. *A* shows the eggs; *B*, the larva or maggot; *C*, the pupa; and *D*, the adult fly.

A bulletin giving full directions for doing this may be obtained from the United States Department of Agriculture, Washington, D.C. Generally speaking, these measures are more difficult and less effective than removing the manure before the maggots have time to mature.

Killing adult flies. It is important to destroy flies that are already hatched; for the same flies may remain about a house all summer unless they are trapped or killed. The giant flytraps, that are now bought or

[1] Floors of stables must be made of cement or other tight material; otherwise the flies will hatch in the crevices and in the earth that becomes soaked with the liquid manure. Usually eggs are laid in manure before it is removed from the stalls, and if it is stored these eggs will hatch unless they are killed by lime or some other substance.

made, fly paper, poisons, and the fly swatter, are all useful in ridding a house of these pests.[1]

The economy of fighting flies and mosquitoes. Under ordinary conditions it is not expensive to remove the

FIG. 97. In a manure pile like this, millions of flies will breed.

breeding places of flies and mosquitoes in a town, and no money that a town can spend will pay better, either

[1] The following hints may prove useful in the warfare on flies: Hang screen doors to open outward and rub them with a cloth dipped in kerosene or carbolic acid solution; make tops of traps of wire or glass so that the flies will come up to the light; use bananas or bread and milk for bait; take away water and food, so that the flies will come to traps or materials placed for them; mix finely ground black pepper with hard boiled yolk of egg or add two tablespoonfuls of formalin to a pint of milk and expose to flies. Neither the pepper nor the milk with the formalin in it is poisonous to children or animals. The milk placed on porches where flies gather is particularly effective on hot, dry days.

in dollars and cents or in the comfort that will come to the inhabitants, than money that is spent to free the town from these insects. In a small town one man can easily look out for all breeding places of mosquitoes. This will mean that there will be no malaria in that town; and there are many small towns that would have been large cities long ago if they had been free from malaria. A town cart can remove weekly all the matter in which flies breed, and this matter can be sold for fertilizer for almost enough to pay for the expense of removing it. Boards of trade often try to improve and advertise their towns. Suppose a board of trade could say: "In our town you will not be bothered by mosquitoes, and neither you nor any member of your family will have malaria. You will not be annoyed by flies, and you need not fear that while you are looking the other way a fly will leave typhoid germs on your plate." Would not a board of trade that could truthfully say this about its town have some facts to present that would interest persons who were seeking new homes?

POINTS TO BE REMEMBERED

1. Flies are very unclean and can carry almost any kind of disease germs.
2. Flies should not be allowed about sick people or about the wastes from the sick.
3. Flies breed in manure and in other waste matter.
4. These breeding places should be removed.
5. Adult flies may be destroyed by traps, fly paper, poisons, and fly swatters.
6. A town that is free from mosquitoes and flies has many advantages over towns that are overrun with them.

CHAPTER THIRTY

DISEASE GERMS IN FOOD

Foods (excepting milk) are not so likely as water to contain disease germs, but when foods become infected they are particularly dangerous, because germs can multiply in them. To appreciate this point you must understand that it is far more dangerous to take a large number of disease germs into the body than it would be to take a few germs of the same kind. A few dozen or a few hundred of almost any of the ordinary disease germs have no power to harm a rabbit when they are injected into its body, but if the dose is increased to several million germs, often the rabbit will die. Its white corpuscles and germicidal substances have the power to kill a few germs, just as the soldiers in a fort can drive away a small company of besiegers who are trying to break down the front gate of the fort. But when millions of germs attack the body at once, the defenders of the body cannot overcome them, just as the defenders of the fort would be unable to resist successfully a great multitude of attackers, who would not only try to enter through the front gate, but at the same time would break down all the other gates and swarm over the walls at every point. It is because in many foods a single germ can increase to a multitude that our foods especially need to be guarded against infection.

How germs get into foods. Not only the germs of intestinal diseases, but also the germs of such diseases as tuberculosis, pneumonia, diphtheria, and scarlet fever, may reach the mouth in food. These germs get into the food from polluted soil, from flies, from washing in impure water the food or the vessels in which food is

kept, from diseased animals, and most commonly of all from the hands of those who are carrying germs.

FIG. 98. Food that has been handled by the public is likely to contain germs.

Those who prepare food should pay special attention to the cleanliness of their hands, washing them often with soap and water (page 161), and no one who is sick with an infectious disease or who is just recovering from such a disease, should have anything to do with the handling or the preparation of foods.

Danger from spoiled food. Besides the germs of special diseases, there are always present in foods the bacteria that cause fermentation and decay.[1] These bacteria do not ordinarily cause sickness in man, but when taken into the alimentary canal in the prodigious numbers in which they are found in foods that are beginning to

[1] If foods are cooked sufficiently to kill all bacteria in them (spores as well as the growing forms of the bacteria), and then sealed away from germs, as is done in cans, they may be preserved for years without decay. Strong salt solutions (brine) will also preserve foods, and strong sugar solutions, such as are used in preserving, will prevent the growth of germs in food.

spoil, they cause fermentation in the intestine, diarrhea, and other troubles. Tainted and soured foods are therefore unsafe and should never be eaten.

Buying foods. The wise person buys his food in a store that is kept clean and where the food is protected from dust and flies. He never buys old and tainted meats or fish, or overripe or decaying fruits or vegetables, for these are swarming with bacteria and are already unfit for use. Above all, he will not buy any food that has been fingered over and handled by the public, for there is always danger that on such foods disease germs have been left from the fingers of some sick or germ-carrying person.

The care of foods. In the care of foods two points are of especial importance. These points are *cleanliness* to prevent germs from getting into food, and *cold*, to keep germs that do get into the food from multiplying. The importance of cooking to kill any disease germs that may be in foods, as well as to kill certain worms that may be in meats, will of course be understood. It should also be understood that by thorough cooking all bacteria of every kind in food may be killed, and that food may be preserved in this way until a new supply of them has time to grow.

Dangers from milk. Of all foods that are used by man, milk is the most dangerous, because without any cooking it furnishes a splendid place for the growth of almost all kinds of germs. Tuberculosis is sometimes contracted from milk, and it is known that typhoid fever, scarlet fever, and diphtheria may be spread by milk. Again and again it has been found that along the route of a certain milkman the people were suffering from

one of these diseases, and on investigation it would be proved that a case of the disease existed among those handling the milk or in their families; or that the bottles had been taken back from families where the disease was; or, in epidemics of typhoid fever, that the milk vessels had been washed in water from wells containing the typhoid germ. One article in a medical journal reported 330 epidemics traceable to milk, of which 195 were typhoid epidemics, 99 were epidemics of scarlet fever, and 36 were diphtheria epidemics. No person who has consumption, or who has recently recovered from typhoid fever or other germ disease, should have anything to do with the milking of cows or the handling of milk. In general, the safest milk is that which is bottled at the dairy where it is produced. If possible, milk should be secured from a dairy that is known to collect and bottle its milk under sanitary conditions. It is difficult for a private citizen to guard against dangers from milk, and in all well-governed cities a health officer looks after the milk supply.

Milk and cholera infantum. Most cases of cholera infantum are due to germs that are in milk.[1] Sometimes, as we have already learned (page 84), it does not seem to be any one special germ that is causing this disease, but the enormous number of many different kinds of bacteria that are in the milk in hot weather. Only pure milk is a fit food for babies, and milk that is filled with a multitude of bacteria and their poisonous toxins is unsafe. Especially in the months when babies are weakened by heat is a pure milk supply important.

[1] Of 9111 infants that died in Berlin, Germany, during 1906, only 844 were fed entirely on their mothers' milk.

FIG. 99. Dairies should be models of cleanliness.

Keeping milk free from germs. All milk vessels and feeding bottles for babies should be thoroughly scalded before using to kill the bacteria in the milk that adheres to them. Otherwise these bacteria will multiply in the new milk, and soon it will be filled with them (page 18). Milk vessels should never be rinsed in any but boiled water, the purest of rain water, or artesian water, for one dangerous germ that gets into the milk from the water remaining on the vessels may grow into a multitude. Milking should be done in a clean building that has fly screens on it, and everything possible should be done to keep dust and hairs out of the milk, for these are loaded with bacteria. The milk should be cooled as quickly as possible, and kept cool to prevent the germs that do get into it from multiplying. It should

be used before it becomes old, for milk that at first has only a moderate number of bacteria in it may soon be filled with countless myriads of them. It is also necessary for a medical officer to examine the cows from which the milk comes, or there will frequently be living tuberculosis germs in the milk (page 59).

Killing germs in milk. When it is impossible to obtain pure milk, it is often best to "Pasteurize" the milk before it is used.[1] This is done by heating it to 170 degrees for a few minutes, or to 145 degrees for fifteen minutes. This kills all disease germs and nearly all the other bacteria in the milk, and the person who uses the milk has fewer germs to resist. A few children do not digest Pasteurized milk as well as they do raw milk, and Pasteurizing old milk that is already filled with acids and toxins from the bacteria that are swarming in it will not make this milk a fit food for a little child. In summer, however, most of the milk sold in cities is greatly improved by Pasteurization, and it is of no small advantage that all the tuberculosis, typhoid, diphtheria, and other dangerous germs that are in the milk are

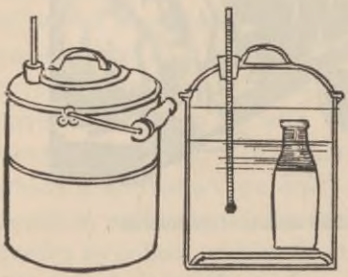


FIG. 100. A vessel arranged for Pasteurizing milk. Very convenient Pasteurizers for use in the home may be purchased at a low price.

[1] Recently many great epidemics of very severe sore throat (*septic sore throat*) have been traced to infected milk. The disease is caused by a streptococcus that causes inflammation in the udder of the cow. Cows probably get the infection from the hands of persons who have the disease.

killed. In fact, so much disease has been found to be due to milk that many health officers believe that all milk should be Pasteurized before it is put on the market, and that the sale of raw milk should be forbidden. After it is Pasteurized, milk should be cooled at once, or soon it will be filled with bacteria again.

POINTS TO BE REMEMBERED

1. Infected foods are particularly dangerous because disease germs can multiply in food.
2. Germs can get into foods from flies, impure water, and from the hands of persons who are carrying germs.
3. Spoiled foods are unfit for use.
4. Foods that have been handled by the public, or exposed to flies, should not be purchased.
5. Cleanliness and cold are the points to be emphasized in caring for foods.
6. Impure and unclean milk is the most dangerous of all foods; tuberculosis, typhoid fever, scarlet fever, and diphtheria may be contracted from it.
7. Cholera infantum is usually caused by unclean or old milk.
8. Milk vessels should be carefully scalded and should be rinsed only in pure water.
9. Milk should be collected in as cleanly a manner as possible and cooled quickly to prevent the multiplication of germs in it.
10. When milk contains many bacteria, it is usually advisable to Pasteurize it before giving it to a little child.
11. Many health officers believe that all milk should be Pasteurized before it is sold or used.

CHAPTER THIRTY-ONE

DISINFECTION

It cannot be too strongly emphasized that nearly all the germs that cause disease in man come from persons who have germ diseases, and that insects, water, and food are dangerous only when they have become infected with germs from some human being. In preventing the spread of infectious diseases, therefore, the most important point is to destroy the germs that come from the bodies of the sick.

Light. Light is destructive to bacteria, and bright sunlight kills many kinds of germs in a few minutes. It is an excellent practice to expose bedclothes and rugs to the sun, and to throw up the shades and allow the sunlight to enter the house. In rooms occupied by consumptives or by pneumonia, diphtheria, or influenza patients, this is especially important.

Drying. Drying checks the growth of all germs, and most germs die if they are thoroughly dried. Damp houses keep alive the germs that are in them, and consumption, pneumonia, and other diseases are more likely to develop in damp than in dry houses. Dirt and dust, mingled with sweat and oil from the skin, on doorknobs, banisters, and furniture, protect germs from light and keep them alive. For this reason the doorknobs and desks in schoolrooms should be cleansed occasionally with soap and hot water.

Heat. Boiling water kills the germs of all common diseases, and handkerchiefs, dishes, and clothing that have become infected can be made safe again by thoroughly boiling them. Sputum and articles of little value may often be most conveniently disposed of by

burning (page 56). The surfaces of dishes contain tiny crevices in which germs lodge, and in disinfecting dishes with hot water, it is necessary to leave them for a few minutes in water that is boiling, so that the heat will reach the germs in the crevices.

Chemical disinfection. Certain chemicals are so poisonous to germs that they are extensively used in disinfecting. A physician should always be consulted as to which disinfectant is best for a particular purpose, and exactly how to use it, for some of them are better for one purpose than for another. Most disinfectants are very poisonous, and a little red ink or other coloring matter should be added to them so that they will not be mistaken for water. The following are some of the most common disinfectants: —

Bichlorid of mercury (corrosive sublimate) dissolved in water, with one part of the bichlorid to a thousand parts of water (1 ounce to 8 gallons of water), kills nearly all kinds of germs in two or three minutes. This disinfectant can be purchased in tablets of the right size to make a pint or half a pint of the solution. For the hands, for washing floors and furniture, and for disinfecting clothing that can be soaked in it, this is an excellent disinfectant. It cannot be used on metals, as it destroys them, and it is not good for disinfecting where there is much organic matter present, as there is in sputum and in the discharges from persons sick with typhoid or other intestinal diseases. It is very poisonous.

Biniodid of mercury is more than twice as powerful as bichlorid of mercury, and need be made only half as strong. It is one of the best general disinfectants, and is especially useful in disinfecting the hands, since it

does not injure the skin. It can be used on metals, and is useful for disinfecting instruments.

Carbolic acid, made up in a 2½ per cent solution (3½ ounces of liquid carbolic acid to a gallon of water, or seven teaspoonfuls to a pint), is a good disinfectant. For disinfecting sputum and other discharges from the body it is well to use a 5 per cent solution.

Lysol is a stronger disinfectant than carbolic acid. It often destroys the colors in clothing. For sputum it is one of the best disinfectants.

Chlorid of lime, used in the proportion of 4 ounces of chlorid of lime to 3 gallons of water, is a cheap and powerful disinfectant. It may be purchased in grocery stores, put up in tin cans under the name of bleaching powder. It cannot be used on colored clothing, and the solution must be freshly made.

Milk of lime is a powerful disinfectant. To make the solution, add one part of freshly slaked lime by weight to four parts of water; or add the hard lumps of quicklime to the water and stir until a thick whitewash is formed. This is a cheap disinfectant, and for disinfecting the body wastes it is as good as anything that can be used. It should not be used in sinks, for it will cause trouble with the traps. Air-slaked lime (lime that has crumbled into fine powder from contact with the air) is worthless, and only quicklime should be used.

Special points in disinfecting. In caring for a case of infectious disease it is well to understand the following special points in disinfection:—

Disinfecting the hands. Any one who is caring for a person sick with an infectious disease should frequently sterilize his hands by holding them in a disinfectant.

Washing the hands thoroughly in a soapy lather will almost free them from germs, and before eating they should be washed in this way and then disinfected. Keeping the nails trimmed and the skin smooth makes the hands much easier to disinfect. The hands of a person who is sick with a germ disease should frequently be washed with soap and water, and should be disinfected occasionally.

FIG. 101. Washing the hands thoroughly with soap and water helps to free them from germs.

Disinfecting body wastes. In typhoid fever and dysentery, the discharges from the intestines and kidneys should be received in vessels containing disinfectants. A strong solution of either chlorid of lime or milk of lime is excellent for this purpose. It is necessary to see that the disinfectant is thoroughly mixed with the waste matter, and it should be allowed to stand for several hours to make sure that all germs are killed. Any matter that is vomited by the patient may contain the germs, and should be treated in the same way as the intestinal and kidney discharges, and all handkerchiefs that a patient may use should be put into hot water or a disinfectant. The wastes from the alimentary canal should be disinfected in consumption and other respiratory diseases as well as in intestinal diseases. Even where there is water sewerage and these wastes can be thrown into the closet with little danger to the family

of the sick person, still they ought to be disinfected; for the germs may reach the water supply of another town, and some one may suffer from them.

Disinfecting in diseases where germs are in the nose and mouth. In diphtheria, pneumonia, consumption, influenza, measles, scarlet fever, and epidemic cerebro-spinal meningitis, the germs are in the discharges from the throat and nose. The instructions given on page 56 for disinfection in cases of consumption apply in all these diseases.

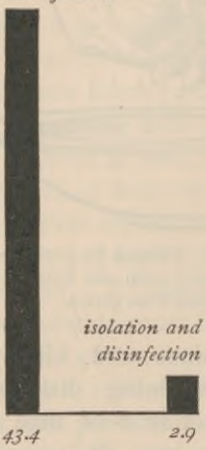


FIG. 102. In Michigan, from 1890 to 1903, there were on an average 43.4 cases in each outbreak of measles where isolation and disinfection were not practised; in each outbreak where these measures were put in force, there were, on an average, only 2.9 cases. (From report of Michigan State Board of Health.)

Disinfecting buildings. Where a room or whole house is to be disinfected, it is usually done by fumigating. Formaldehyde is best for this purpose. Special directions are necessary for this work if it is to be done effectively. Quicklime is a good disinfectant for cellars and closets.

Mistaken ideas in regard to disinfection. It is a common idea that there is some connection between the smell of a substance and its power as a germ-killer. Strong-smelling substances are sometimes burned in sick rooms, or a little carbolic acid is exposed in a saucer, so that it will scent the air of the room. It need hardly be pointed out that germs are not injured by anything of this kind.

The importance of disinfection. Our second great law for the prevention of germ diseases was to keep germs from the bodies of the sick from being scattered abroad. This can be done only by disinfection, and if all families would learn the value of disinfection and practise it, perhaps the most important step in the prevention of germ diseases would be taken.

Isolating the sick. People need to learn that sick persons should be kept away from those who are in health. This is best for both the sick and the well. It is possible to practise disinfection efficiently only when a sick person is kept in a room by himself, and the careless visiting in sick rooms which is allowed in colleges, boarding schools, and most families, is a cause of much disease. Figure 102 shows how effective isolation and disinfection are in checking the spread of measles, one of the most infectious of all diseases.

POINTS TO BE REMEMBERED

1. Disease germs come from the bodies of diseased people.
2. Light and drying kill germs.
3. Heat is an excellent disinfectant.
4. Certain chemicals poison and kill germs.
5. A physician should be consulted as to the best disinfectants to use for particular purposes.
6. There is no reason to think that a substance is of any value as a disinfectant because it has a strong odor.
7. Disinfection and isolation are very important measures in checking the spread of germ diseases.

CHAPTER THIRTY-TWO

UNHYGIENIC HABITS

As we have said again and again in former chapters, nearly all disease germs leave the body by way of the mouth and nose, or in the wastes from the alimentary canal and kidneys, and most of them get into the body through the mouth and the nose, especially through the mouth. In their daily life, many persons have fallen into certain habits that make it easy for germs to get into the mouth and nose, and into other habits that scatter germs abroad where they are likely to do harm.

FIG. 103. It is never safe to use public drinking cups.

Putting objects into the mouth. The habit of putting into the mouth pencils, coins, candy, chewing gum, or any other object that has been in the mouth of another person, gives germs an opportunity to pass directly from

one mouth to another. A public drinking cup on a train, at a public fountain, or in a school, is certain to be used by some one with disease germs in his mouth.[1] If another person then drinks from the cup, the germs have as good an opportunity as a germ could wish to pass into the mouth unweakened by drying. Each pupil in a school should have his own cup, and a private cup should always be carried when traveling; but if it is necessary to drink from a public cup, it is best to put both lips into the cup while drinking. This is because the germs are more likely to be sticking to the edge of the cup (in mucus from the lips of persons who have previously used the cup) than to be floating free in the water.

FIG. 104. Rubbing the eyes and putting the hands to the face are bad habits.

Putting the hands to the face. Another habit that we would mention is that of allowing the fingers to touch the face, eyes, or lips. In many ways — from books, doorknobs, pencils, seats, and straps in street cars, and from the hands of other persons — we get germs on our hands. It is advisable, therefore, to form the habit of keeping the hands away from the face. Especial attention should be given to this point when sore eyes are prevalent. Before eating,

[1] On a drinking glass that had been touched by the lips, 20,000 bacteria were found, and 5000 on a glass slip touched by a thumb moistened with saliva, as the leaves of a book are often touched with a moistened finger or thumb in turning them.

the hands should be thoroughly washed with soap, for this is a very wonderful remover of germs.

Exchanging books in the schoolroom. Where school-books are furnished by the town or state, they are sometimes given out each morning, and it is only by chance that a pupil receives the same book on two successive days. This is not right, for the germs of diphtheria, pneumonia, scarlet fever, and of other dangerous diseases may be spread through a school by the books. Each child should keep the same books throughout the year, and passing books about from one pupil to another should be discouraged. It might be added that writing paper is more sanitary than the slates that are still in use in some places, for slates are often wet with saliva, and the sponges that are used on them are generally reeking with germs.

Drinking water to which one is not accustomed. When one is away from home on a short journey (as on a visit to a city or to an exposition), it is often not possible to be sure whether the water that is provided for drinking purposes is safe or not. It is, therefore, the part of wisdom to take a supply of water from home, or to drink mineral water or boiled water, or even tea or coffee. By drinking water from various sources, while on their vacations, hundreds of people every summer contract typhoid fever. Strangers coming into a place that has an impure water supply are always far more liable to contract typhoid fever than the inhabitants of the place, who are accustomed to the water, and almost any strange water is likely to cause intestinal disturbances that may spoil all the pleasure of a short visit or excursion.

Spitting. In previous chapters your attention has been repeatedly called to the fact that many germs may be in the mouth. That these germs are certainly scattered about by spitting, every one must understand. Tobacco spit is as bad as any other kind of spit, and every one must learn that to spit at all is not only an unclean and disgusting habit, but one that is very insanitary. Many cities have laws against spitting in public places. These laws are founded on common sense and should be supported by all good citizens. Every one should at least have enough care for others to spit in the gutter and not on the sidewalk, for on the sidewalk the germs are almost certain to be carried on the feet of passers-by and on trailing skirts into the houses, stores, and offices.

Washing the teeth in wash basins. Cleaning the teeth in a wash basin will leave any germs that may be in the mouth in the wash basin, and you will readily understand how easy it would be for a few hundred thousand of these germs to get to the mouth of some one else who washes his face in the basin. A bathroom should have a sink over which the teeth may be cleaned, and in cars and public wash rooms some other place than the wash basins should be provided for cleaning the teeth. In a public wash room the safest plan is to turn on the water and wash in the stream as it comes from the faucet.

Scattering the germs of intestinal diseases. We come now to one of the most important and the most difficult of all the questions of sanitation, the question of how to prevent the spread of the germs of intestinal diseases. It is utterly amazing the way these germs now get scattered abroad, and the more we study the subject

the more we realize how unclean a creature man really is; for we must remember that every one of the million of cases of intestinal diseases that occur yearly are caused by germs that have escaped from the human body in the wastes from the alimentary canal and kidneys. In towns and in the country, where there is no water supply, the greatest care must be taken in disposing of these wastes, or disease will surely come from them. Where a city is supplied with water and has a sewer system, it is not difficult for a person or a family to know how to dispose of these wastes; but if the city disposes of its sewage by running it into the nearest stream, the people down the stream will probably suffer.

The danger of polluting soils. In the last few years a very important discovery has been made. This discovery is that it is not an uncommon thing for healthy persons to carry very dangerous germs, and that the germs of all the infectious diseases of the intestine (cholera, typhoid, dysentery, and diarrhea) may be carried by persons who are not themselves ill (page 79). So many cases of intestinal diseases come from well persons, that it is unsafe to allow the soil about a house to be polluted by the wastes of any human being, whether he be sick or well. If the soil does become infected with dangerous germs, these germs will be carried about by flies, they will be taken by the feet into houses and to well platforms, and sooner or later they will almost certainly reach the mouths of others. Also, the intestinal worms (page 135) that are so great a scourge in the southern part of the United States are spread entirely through the pollution of the soil. It is perfectly evident that no wastes from the

human body should under any circumstances be allowed to touch the soil of dooryards. Closets where these

FIG. 105. Children often become infected with disease germs by playing in unclean places.

wastes can be kept from becoming scattered and the germs in them can be destroyed, should be built.[1]

Allowing children to play in the dirt. It is the children, more than any other persons, who suffer from germ

[1] The discharges from the kidneys are dangerous as well as the intestinal discharges, for they very commonly contain streptococci, and they may contain the bacilli of typhoid fever.

diseases. One reason, and doubtless the main reason, for this is that children have less resistance to these diseases than have those who have grown up. Another reason is that children crawl and play on the floor and earth where their elders spit, and where all kinds of dangerous germs are left by the feet of those who have walked on the streets or on polluted soil about the house. Babies should not be put down to play on dirty floors or in dirty yards, nor should they be allowed to put into their mouths objects that have been soiled by dropping them in such places. More than any one else little children need to be guarded against germs, and for their sakes, especially, floors and yards should be kept as clean as possible.

POINTS TO BE REMEMBERED

1. Many people have fallen into habits that make it easy for germs to get into the mouth and nose.
2. Putting objects into the mouth, drinking from public cups, allowing the fingers to touch the face and lips, and drinking water from unknown sources, give germs an opportunity to enter the body.
3. Spitting, cleaning the teeth in wash basins, and polluting the soil are practices that scatter disease germs.
4. The disposal of sewage and the prevention of soil pollution are among the most important questions in all sanitation.
5. Children should not be allowed to play in the dirt, for children, more than older persons, suffer from germ diseases.

CHAPTER THIRTY-THREE

PUBLIC SANITATION

The wild man of the forest lives to a great extent alone, but civilized people cannot be independent of each other. Civilized people therefore have governments. The advantages of having a government are so many and so great that no person of intelligence can fail to understand them. Many persons, however, fall into the habit of complaining about their taxes, and fail to understand that the government is a great partnership into which all the people have entered for the good of all, and that for no other money expended do they get so much in return as for the money paid to the government. We will therefore turn away for a short time from the study of sanitation while we try to get a clearer idea of the advantages that come from having a government — advantages so plain that they have caused every civilized people that has ever existed on the earth to establish a government.

The advantages of government. Each person who walks the streets of a city cannot hire a policeman to protect him, and it would not be possible for every family to own a fire engine. Every farmer who wishes to drive over the country cannot afford to build roads and bridges wherever he may wish to go, and only a few families have enough wealth to pay the entire cost of a capable teacher for their children. But if each family will pay but a small sum into the public treasury, the government can provide police and fire departments, look after the roads, and educate the children of all the people. A government is of advantage to the people who live under it *because at a small cost to each person it*

gives to its citizens many advantages that they could not have in any other way.

In a city firearms should not be used, and automobiles and wagons should not be driven too rapidly through crowded streets, because if this is done, many accidents are sure to occur. In the country, a farmer should not turn his cattle and horses out on the public road, for they may injure his neighbor's crops. Yet no one person has authority to lay down rules in regard to the way another shall use a gun or drive an automobile or a wagon, and one farmer cannot force another to keep his cattle off the roads. Only a government with authority over all the people can do this, and it is a great advantage to have a government *that can forbid every one's doing those things that are harmful to the welfare of others*; for there have always been and are now in the world many persons who have little regard for the rights of others.

Government a partnership. From the above you will see that in reality a government is a great partnership. Each partner (citizen) is forbidden to do those things that would be injurious to others, and each partner is required to pay a certain sum of money (his taxes) into the public treasury each year. With this money the government hires done those things that are necessary for the welfare of all. One of the first duties of a government is to guard the health of its people, for as long as a community is greatly afflicted with disease, it cannot make much progress and its people cannot have much happiness.

The need for public health officials. It is not possible for an individual to protect himself from disease if those about him are carelessly scattering germs abroad.

Only some one with authority over all the people can guard the health of a community, and public health officials are absolutely necessary if sanitary measures are to be enforced. Only those who have been specially trained for the work have the skill that is necessary to fight infectious diseases successfully, only those who are paid to do so can give to the work the time and attention that are required to make the fight successful, and only those with authority to do so can compel careless and unclean citizens to live in a sanitary manner. Without health officials certain persons in every community will keep breeding places for mosquitoes, hatch swarms of flies in great manure piles on their premises, spit on the sidewalks and in other public places, neglect to be vaccinated, or go straight out among the people from cases of very dangerous and very infectious diseases. Without officers of the law certain bad citizens always rob and steal, and these citizens must be forced to let the property of others alone. So in matters of sanitation, the ignorant and the careless citizens must be forced to live so that they will not be a source of danger to those about them.

Supporting health officials. No thief thinks well of the policeman who arrests him, and no murderer loves the judge who sentences him to be hanged. So the persons who are compelled to clean up their premises and live so that they will not be a nuisance and a source of danger to their neighbors often become angry with the health officials and try to injure them and hinder their work.[1] It is therefore the duty of every one to

[1] The greatest problem of the health official is the influential citizen who opposes any measures that may inconvenience him and insists on his right to

assist and encourage health officials, and we should always remember that they are trying to save us and not themselves from disease. Whatever they do is done for the good of the people over whom they are watching, and no man can claim to be a good citizen if he deliberately hinders one who is trying to save helpless men and women and innocent little children from disease and death. Especially should a man who claims to be a good citizen, stay in quarantine when he is ordered to do so. For deliberately to scatter abroad disease germs is a crime, and the man who does it knowingly deserves to be treated as other criminals are treated.

The economy of public sanitation. Many persons agree that public sanitation is a good thing, but think that the town or state in which they live cannot afford it. These persons do not understand what preventable diseases are costing their communities, or they do not understand political economy. For any man can afford to spend two dollars if thereby he can save ten dollars, and any community that spends money on public sanitation will save far more in the time that has been lost on account of sickness than it spent in trying to preserve the health of its citizens. The typhoid epidemic at Plymouth, Pennsylvania, cost nearly $100,000, and the persons who died in it were earning in wages $18,000 a year. Lawrence, Massachusetts, put in a water filter, and in four months the filter prevented enough typhoid to pay for itself. If the American people would use one half the sum that tuberculosis is costing them each year in fighting the disease, it is probable that tuberculosis would soon cease

be a menace and a nuisance to all his neighbors. — AN AMERICAN HEALTH OFFICIAL.

to exist. A conservative estimate places the cost of preventable germ diseases in this country at $1,500,000,000 a year, and if this money were used in fighting these diseases, most of them would soon be practically stamped out. The United States government appropriated $100,000 to destroy rats around San Francisco, and some persons thought that this was a great sum of money to spend for such a purpose. Yet the rats themselves, to say nothing of the plague that they carry, do six hundred thousand dollars' worth of damage every year in a city like San Francisco, and in the whole country they do fifty million dollars' worth of damage. Many towns everywhere think they cannot afford a public water supply, and yet every few years each one of these towns pays out more than the cost of a water system because of intestinal diseases. One such town the writer knows, a town of about two thousand inhabitants. Every year this town has from twenty to thirty cases of typhoid fever (besides other intestinal diseases) with two or three deaths, and every two years the people of the town spend enough on typhoid fever alone to pay for the water system that they think they cannot afford. Count up the number of cases of typhoid fever, the number of cases of consumption, or the number of persons who suffer from malaria in your town, and see if the people of the town are not acting in a very extravagant manner when they neglect public sanitation. You will certainly find this to be the case.

The common sense of sanitation. In a former chapter (page 144) we spoke of the sanity of sanitation. At this time we wish to call attention again to the fact that it is foolish to live in a way that we know will lead to dis-

ease. It is cheaper to live in a town where the sidewalks are clean, the streets sprinkled, the houses supplied with pure water, the sewage safely cared for, the milk supply clean, flies and mosquitoes banished, and skilled health officers employed to watch for and prevent infectious diseases, than it is to live in an insanitary town. It is certainly more pleasant to live in a clean than in an unclean town; at least it is more pleasant to be well in a clean town than it is to be sick in an unclean one. The only sensible thing for any community to do, therefore, is to have public sanitation, and free itself as much as possible from germ diseases.

POINTS TO BE REMEMBERED

1. In civilized communities no one lives to himself, and governments are necessary.
2. Governments give to their citizens many advantages that they otherwise could not have, and they prevent the ignorant and selfish citizens from harming others.
3. In a government each citizen is a partner.
4. The preservation of the public health is one of the first duties of a government.
5. Public health officials are necessary to carry out sanitary measures.
6. Good citizens should support health officials.
7. Sanitation is economical, for it is cheaper — very much cheaper — to prevent most germ diseases than to suffer from them.
8. Sanitation is sensible.

CHAPTER THIRTY-FOUR

WHAT GOVERNMENTS CAN DO TO PRESERVE THE PUBLIC HEALTH

JUST what a government should do to preserve the health of its citizens depends on whether the people over whom it is watching live in the tropics or in the colder portions of the earth, and on whether they are in cities and towns or in the country. Yet the principles of sanitation are everywhere the same — *the government must do those things that are necessary to the health of the community which the people cannot do for themselves*, and *it must compel every one to live in such a way that he will not be dangerous to others.* From your study of former chapters of this book you will understand many of the duties of a government that are connected with preserving the health of a people. We will, however, point out a few of the more important ways in which a government can save its citizens from disease.

Quarantining in cases of epidemic diseases. One very important duty of a government is to quarantine cases of epidemic diseases. If you had a handful of weed seeds in a cup, you could easily destroy them by throwing them into the fire. But if some one should scatter these seeds over your garden and lawn, it might be a work of months to get rid of the weeds that would grow from them. So in epidemic diseases it is easy to quarantine a single patient and keep the germs from being spread abroad, but it is very difficult to control some of these diseases after the germs have been scattered. Some physicians, even, do not appreciate the importance of this fact, and instance after instance could be given of great epidemics of disease that could have been entirely prevented if the first cases had been promptly dealt with.

Not only may a community injure itself by failure to enforce quarantine, but it may injure some other community that is far away. The man who started the great smallpox epidemic in Montreal (page 124) came from Chicago, and the man who caused the typhoid epidemic at Plymouth, Pennsylvania (page 88), came from Philadelphia. What we need all over the country and all over the world is such careful quarantining of infectious diseases that they will be driven from the earth. Both for the sake of its own people and for the sake of people in other places, every community should enforce strict quarantine of each case of sickness that has the appearance of smallpox, yellow fever, diphtheria, or other epidemic disease, until it is known that the disease is one that is not dangerous to the public health.

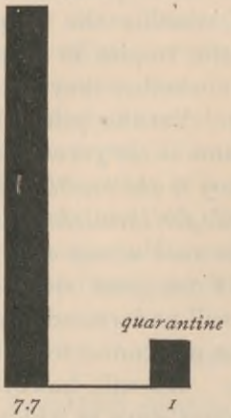


FIG. 106. From 1866 to 1875, when quarantine was not enforced, the average annual death rate from scarlet fever in Massachusetts was 7.7 for every 10,000 inhabitants. From 1896 to 1905, when quarantine was strictly enforced, the average annual death rate from scarlet fever was 1 for every 10,000 inhabitants.

Building hospitals and sanatoria. Governments should build hospitals to which persons who are suffering with severe epidemic diseases can be taken. This not only prevents the spread of these diseases, but is best for the patients also; for hospital physicians who have made a special study of epidemic diseases have the greatest skill and experience in treating diseases of this kind.

It is the duty of the government also to provide sanatoria where persons who are suffering from long-continued cases of infectious diseases can go. There are 500,000 consumptives in the United States, and in all the institutions of the country there are enough beds, pay or free for only a small part of these consumptives. Our country has no greater need today than sanatoria that will stop the spread of this disease and will give its victims the treatment that they need.

FIG. 107. Governments of cities and towns should keep down dust in the streets.

Providing a pure water supply. In the country it is usually possible for a family that is willing to use a reasonable amount of care and intelligence to provide itself with a pure water supply. In cities and in larger towns where the people are crowded together the soil always becomes polluted and well water is impure. It then becomes impossible for each family to secure a safe water supply, and it is the business of the city to furnish a supply of pure water for all the people. If a city fails to do this, many of its people will die of intestinal diseases. For the experience of the whole world is that cities and towns that must depend on shallow wells and on streams for their water are greatly scourged by intestinal diseases, while cities and towns that have pure water are comparatively free from these diseases.

Providing a system of sewage disposal. It is absolutely necessary for any government that wishes to preserve the health of its citizens to provide some method for the disposal of sewage. Where there is a water supply and a system of sewers, the problem is made easy for each family. Where there is no water and no such system of sewers, the government should take up the work of cleaning out all closets, and should provide carts to haul the matter in them away where it can do no harm.

FIG. 108. In a city the government should assist the citizens to keep their premises in a sanitary condition.

It is not enough for the government of a town to pass laws requiring that all closets be kept in a sanitary condition, for where families live on small lots the only safe way to dispose of the matter in closets is to haul it away, and it is a waste of money to require each separate family to hire this done when the government can have the same work done at a fraction of the cost to the people. In small towns that have no water supply the question of sewage disposal is of special importance. For the sanitary condition of a town is hopeless as long as it has neither a water supply nor a system of sewage disposal. It might be added that a town which provides some way of purifying its sewage before running it into a stream to infect the water supply of another town, is doing nothing more than to follow the Golden Rule.

Collecting vital statistics. In all the leading countries

of the world except the United States, a record is kept of all deaths and the causes of them. In over one half of our country, statistics in regard to the number of deaths and the diseases that cause them are collected, but in the remainder of the country this very important duty of the government is neglected.

Why vital statistics are important. If typhoid fever is a common disease in your town, the water supply needs to be improved. If a large number of little children are dying from intestinal diseases, the milk supply as well as the water supply should be looked after. If scarlet fever and diphtheria keep interfering with the schools and causing more deaths than they cause in other towns, your health officers are not quarantining and disinfecting as well as they do in other places. If the death rate from malaria is high, a campaign against mosquitoes should be undertaken.

How are we to find out whether or not infectious diseases are more common in a town than they should be? By keeping a record of all cases of these diseases and the number of deaths that they cause and comparing our figures with the figures from other places. How are we to tell which diseases are most important in our communities? By keeping a record and comparing the number of deaths caused by each. No one can tell what diseases are most common in a town without vital statistics. No one can tell whether or not sanitary measures are improving the health of a town as they should unless an account is kept of the number of deaths in the town before and after these measures are taken. All of us have lived among tuberculosis all our lives, but how many of us dreamed that tuberculosis was as im-

portant a disease as it is, until the facts were collected and set down in cold figures? "Let us have facts, real, unmistakable facts; for without facts there can be no true science."

How death rates are calculated. If you should examine the report of a health official, you would probably find in it death rates for the month or year for the city or state as a whole, and death rates for different diseases. At first these death rates may seem a little confusing, but when we understand how they are calculated they are in reality very simple. *The death rate of a country means the number of deaths in that country for each* 1000 *inhabitants.* In 1911 the death rate in the United States was 14.2 for that part of the country in which vital statistics are kept. For the same year it was 14.6 in England and Wales, 9.3 in New Zealand, 25.1 in Hungary, 13.8 in Sweden, 19.6 in France, and 23.2 in Spain. This means that in each of these countries there were as many deaths for each 1000 inhabitants as the figures given above show. Name some of these countries in which the sanitary conditions are probably not good.

The death rates that are given for different diseases mean the number of deaths caused by these diseases for each 100,000 *of population.* In 1910 the death rate from typhoid in England and Wales was 5. In the United States it was 23.5 (where statistics are kept). This means that in England and Wales there were 5 deaths from typhoid fever for each 100,000 of population, and in the United States there were 23.5 (more than four times as many) deaths from typhoid for each 100,000 inhabitants. In our country the death rate in 1912 was .3

from smallpox, 9.3 from whooping cough, 18.2 from diphtheria and croup, 149.5 from tuberculosis, 11.5 from meningitis, and 132.2 from pneumonia.

Which of these diseases is it most important for us to check? Why do you suppose typhoid fever is so much more common in the United States than in England? Look over the table on page 184 and suggest sanitary measures that the people of certain places ought to put into practice.

How to study vital statistics. The best way for you to begin the study of vital statistics is to examine the figures for your own city or town and then compare them with figures from other places. Ask your health officer for a copy of his last annual report and look for the tables showing the cases of infectious diseases and the causes of deaths. Make a table showing the number of deaths from these diseases and compare them with the figures from other places. Then make a list of the sanitary measures that you think would most improve the health of your town. If your health officer has no report of this kind, your town and your state ought to pass laws that will make it possible for vital statistics to be collected. For a health officer who is compelled to do his work without vital statistics is in exactly the same position that a merchant would be in if he were compelled to run his business without keeping any books.[1]

Reporting cases of infectious diseases. All cases of infectious diseases should be reported to the health officials, and they should keep a record of these cases.

[1] In some states very useful reports on vital statistics can be obtained from the State Registrar of Vital Statistics at the capital of the state.

DEATH RATES FOR THE YEAR 1911

	General Death Rate (Standardized)	Typhoid Fever	Malaria	Smallpox	Measles	Scarlet Fever	Whooping Cough	Diphtheria and Croup	Influenza	Tuberculosis	Meningitis	Pneumonia	Diarrhea (Under 2 years of age.)	Violence (Accidents, homicides, etc.)
United States: Total	13.7	21.0	3.0	0.2	10.0	8.8	11.3	18.9	15.7	158.9	12.3	133.7	77.4	91.1
White	13.7	19.9	2.3	0.2	9.9	9.2	10.4	19.3	15.3	146.0	12.0	128.4	75.9	88.7
Colored	23.7	44.9	19.8	0.6	11.1	1.6	31.5	9.8	23.9	450.8	17.9	252.2	111.0	146.0
Massachusetts	15.0	9.0	0.4	0.1	8.9	5.7	14.6	16.8	10.0	153.2	14.6	153.8	103.2	92.5
New York City	15.2	10.9	0.7	0.1	13.2	15.1	7.5	25.6	6.9	207.1	9.6	209.6	92.6	84.3
Chicago, Ill.	16.4	10.9	0.4	0.1	5.8	21.9	2.3	38.2	8.0	166.8	10.1	200.7	132.6	94.5
Richmond, Va.: Total	23.2	17.8	1.5		8.5	2.3	31.7	10.1	17.8	250.4	10.8	158.6	158.6	114.5
White	17.7	19.5	1.2		8.5	2.4	19.5	14.6	13.4	162.3	9.8	90.3	115.9	83.0
Colored	32.6	14.8	2.1		8.4	2.1	52.8	2.1	25.3	403.3	12.7	276.6	232.3	168.9
Indianapolis, Ind.	15.3	25.8	2.9		1.2	3.7	7.5	17.1	9.6	188.6	11.7	110.0	56.6	83.7
Seattle, Wash.	10.4	10.3	0.4	0.4	5.1	2.8	7.5	8.7	6.7	121.1	4.4	53.0	23.7	75.2
New Orleans, La.: Total	21.8	31.0	10.7	0.6	11.3	1.2	28.1	7.2	26.6	260.5	15.1	161.8	136.9	114.6
White	16.7	23.2	6.7		13.8	1.6	28.7	6.7	23.6	173.2	13.4	102.3	128.7	83.8
Colored	35.4	52.6	21.9	2.2	4.4		26.3	8.8	35.0	503.8	19.7	327.4	159.9	200.4

The general death rate shows the number of deaths from all causes for each 1000 inhabitants. The death rates for the different diseases show the number of deaths from each of these diseases for each 100,000 inhabitants. Where more than ten per cent of the population is colored, the white and colored death rates are given separately. Make out a list of death rates for your state and city and compare them with the rates in this table.

Then the officials can know whether children are attending school from a house where there is whooping cough or measles. They can then make sure that cases of scarlet fever and diphtheria are quarantined. They can see that the wastes from typhoid patients are destroyed, and they can do something to help consumptives and to prevent their spreading the disease. Every law providing for vital statistics should require physicians to report all cases of infectious disease to health officials as early as possible.

Other duties of the government. A government should further guard the health of its citizens by keeping a watch for germ carriers who may start epidemics, by disinfecting houses where consumptives have lived, and by vaccinating its citizens against smallpox. It should remove or cause to be removed the breeding places of flies and mosquitoes, and where there is danger of plague, it should wage war against rats. It should guard the milk supply, and put in force measures for keeping down dust. It should prohibit spitting in public to guard against consumption especially. Dispensaries where consumptives and mothers with sick babies can be advised and assisted are good investments for any city or state. It is also the duty of a government to provide sanitary school buildings and clean playgrounds for its future citizens, and to have medical inspectors keep

Vital statistics for any part of the United States where they are kept and estimated populations for non-census years for states and cities of more than 8000 inhabitants may be obtained from the annual reports on Mortality Statistics, published by the United States Bureau of the Census. Your health officer probably has a copy of this book, and he will doubtless allow you to copy from it any figures that you may need in your study of this subject.

watch over the children in the schools. Above all else a government should educate its people in regard to preventable diseases.

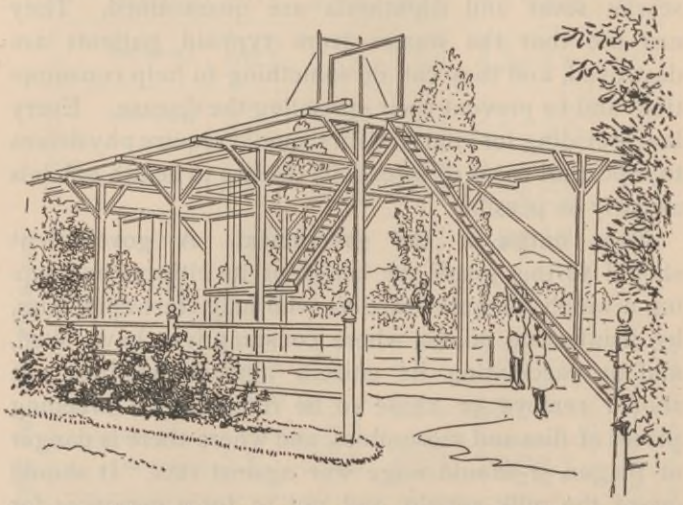


FIG. 109. Cities and towns should provide places where children can play without danger from disease germs.

POINTS TO BE REMEMBERED

1. A government should quarantine epidemic diseases.
2. It should build hospitals and sanatoria where the victims of infectious diseases may be cared for.
3. It should provide a pure water supply for its citizens.
4. It should provide a system of sewage disposal.
5. It should collect vital statistics.
6. It should carry out such other measures as may be necessary to protect its citizens from preventable disease.

CHAPTER THIRTY-FIVE

PRACTICAL SANITATION

We have now made a study of the common germ diseases and of the sanitary methods that may be employed to prevent these diseases. The question now is, what can a few people do to improve the sanitary condition of a community? All great works take time, and to reform a town that is a total stranger to all sanitary measures usually requires years of patient effort. By intelligent work, however, a community can soon put itself in better sanitary condition and begin to cut down the number of deaths from infectious diseases in the community.

Educating the public. The chief trouble in carrying out sanitary measures is that many people do not understand anything at all about germ diseases. There are in our country many persons who do not yet know that malaria is carried by mosquitoes, or that a person who is only slightly ill, or not ill at all, may be carrying typhoid germs. These persons cannot understand the importance of sanitation. Neither do they carry out sanitary measures intelligently when they do try to improve the healthfulness of their surroundings, for it is an easy matter to look in the wrong place for germs. Every one, therefore, who spreads a knowledge of disease germs is helping the sanitary condition of his community, for where knowledge of disease germs goes, there intelligent and successful efforts to escape from them will soon follow.

Sanitation in cities. A great city can be kept in sanitary condition only by the government, and a citizen can best serve the cause of sanitation in a city by

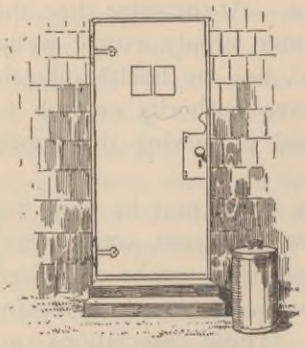
working through the health officials. The good citizen should use his powers to have honest, intelligent men elected to office, and he should support measures that will give these men enough money to have the health of the city properly guarded. In every city there are candidates for office who seek the support of the people by professing to believe in an economical government and a reduction of the taxes. In many cases it is possible to reduce the taxes only by allowing the schools, the police and fire departments, the streets, the parks and public playgrounds, and other interests of the city to run down, and by turning disease germs loose to work their will on the people of the city. The citizen who wishes sanitation in his city should therefore, first of all, interest himself in the life of the city and see that the right men are given control of public affairs, and he should advocate sanitary measures and everywhere preach the doctrine that public sanitation is not possible without expending public money. The citizen can also best do his part in the great sanitary work which a state and a nation should carry on by upholding faithful health officials and by reporting any who may be lazy or careless about their work.

Sanitation in villages. From a sanitary point of view, the position of many villages and small towns is most melancholy. Enough people have collected in them to make it impossible for any one family to protect itself by its own sanitary efforts, as a family can do in the country. Even in a small town there are enough people to keep many rain barrels that will breed mosquitoes, many manure piles that will hatch flies, many offensive closets to threaten the health of the town. Enough peo-

ple can collect about the post office or the store in the smallest village to cover the sidewalk in front of the buildings (and sometimes the floors of the buildings themselves) with expectorations. At the same time, the small town usually has no water supply except wells, no system of sewage disposal, and no health officials who are paid enough and have authority enough to allow them to do much toward preserving the public health.

In these towns and villages much may be done for the cause of sanitation by a few intelligent, active workers. Village improvement associations can be organized to study how the town may be made a more healthful and pleasant place to live in. These associations can help to educate the people in regard to consumption and other diseases that are always in the village. They can keep before the public the necessity for having clean playgrounds for small children. They can encourage the people to sod along the sidewalks and to set out trees, and this will help in keeping down the dust. They can use their influence against spitting on sidewalks and can find other ways to assist in keeping the streets clean. Above all, they can uphold the physician who is acting as health officer when some one in the town becomes offended at him, and they can exercise a great influence on the officials of the town. If the members of a town council know that the intelligent people of the town want the breeding places of insects to be removed, the weeds in the streets to be cut down, the closets in the town to be kept in a sanitary condition, the streets to be sprinkled, and at the earliest possible moment a water supply to be provided for the town, they will be more likely to look

after these things than they will if no one thinks or says anything about the health conditions of the town.



FIGS. 110 and 111. Which of these will permit the people in the house to make the more effective fight for sanitation ?

Freeing the country farmhouse from disease. In the country insanitary neighbors are not so great a danger as they are in towns and cities, and by intelligent effort a family in the country can to a great extent free itself from germ diseases. If country families will clear away weeds and dense shrubbery from around their homes, and look after the breeding places of mosquitoes, they can do much to protect themselves against malaria. By removing the breeding places of flies, avoiding the polluting of the soil about their homes, and guarding their milk and water supplies, they can in a great measure free themselves from intestinal diseases. Sunlight admitted freely to the house is one of the most powerful disinfectants known, and the fresh country air admitted freely to the sleeping rooms at night will do much to build up the body and increase its germicidal power.

Germ diseases are almost as common in the country as in the city, but with a little care a family in the country can avoid most of them.

The necessity of setting a good example. He who would be a successful preacher of any doctrine must himself be willing to put into practice that which he preaches, and he who would help the cause of sanitation

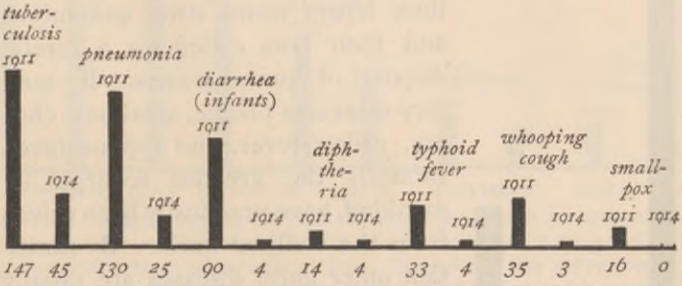


FIG. 112. In March, 1912, Robeson County, North Carolina, appointed a physician to give his whole time to looking after the health of the people. The diagram shows the number of deaths from certain diseases, in 1911, the year before the health officer began work, and in 1914, after he had been at work three years. Fifty-five per cent of the people in the county are colored.

in his community must first of all see that his own premises are in a clean and sanitary condition. The family that keeps a rain barrel to breed mosquitoes need not complain if a neighbor keeps a manure pile for the hatching of flies; the man who spits on the sidewalk need not be surprised if a passing consumptive leaves a swarm of tuberculosis germs by his front gate; and the family that keeps an offensive closet behind the house is in no position to make a successful fight for better sanitation in the town. The first and greatest service that we can render the cause of sanitation is to cease to offend against sanitary laws ourselves; and this will not be

without profit to us, for, after all, most families suffer from germ diseases more because of their own carelessness than because of the faults of others.

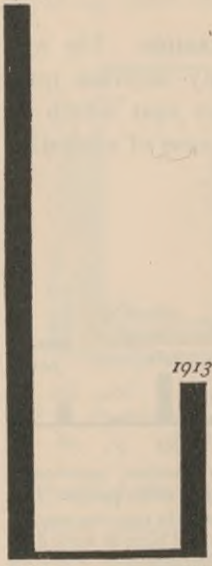


FIG. 113. Diagram showing the death rate from typhoid fever in Jacksonville, Florida. In 1910 there were 8500 open closets in the city. By 1913 these closets had been screened against flies. No other changes in the sanitary condition of the city that would affect the typhoid death rate were made during this time.

Practical results of sanitation. Sanitation is nothing new, for several thousand years ago the Jews kept their lepers under strict quarantine, and their laws called for a careful disposal of human wastes. By sanitary measures plague, smallpox, cholera, yellow fever, and typhus fever, formerly the greatest scourges of mankind, have practically been driven from the civilized world. By sanitation other germ diseases are rapidly being controlled, and there is hardly an infectious disease that can be mentioned that has not been either banished or seriously checked in many communities. For thousands of years sanitation has been tried and proved to be a great success, and its advocates today are only asking that the measures that have freed us from our worst plagues shall be used to free us from the lesser diseases that still afflict us. Figures 112 and 114 show what has been done in a few years to check some of these diseases, and as yet we have hardly begun to fight them with the idea of driving them from our land.

When we can keep the germs that are in the bodies of the sick from getting to those that are free from these germs, then nearly all cases of germ diseases will disap-

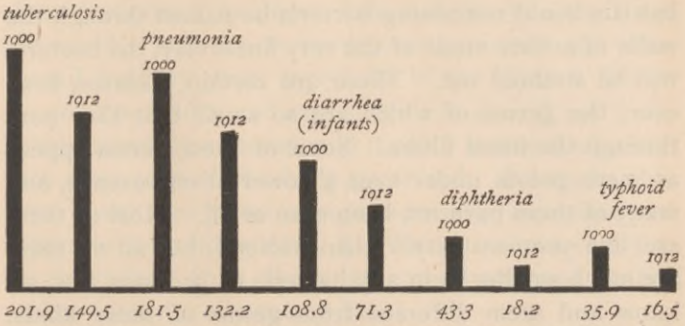


FIG. 114. Diagram showing the death rate (number of deaths per 100,000 inhabitants) from certain infectious diseases in 1900 and in 1912 in the part of the United States where vital statistics are kept. Sanitation is now saving tens of thousands of persons from dying of these diseases each year, and our health officials know how to save tens of thousands more.

pear from the earth. That it is possible to do this in the great majority of cases, all experience in sanitation abundantly proves.

POINTS TO BE REMEMBERED

1. Education in regard to germ diseases always helps the cause of sanitation.
2. In cities, states, and nations, citizens can best serve the cause of sanitation by supporting the health officials.
3. Most small towns and villages need sanitary reform.
4. In these places much can be done for sanitation by educating the people and by interesting the local officials.
5. A country family can largely free itself from germ diseases.
6. Experience shows that by sanitation most germ diseases can be completely banished or at least greatly checked.

CHAPTER THIRTY-SIX

A NEW KIND OF DISEASE GERM

BACTERIA can easily pass through the pores of a brick or the pores in the walls of a vessel made of coarse clay, but if a liquid containing bacteria be passed through the walls of a filter made of the very finest clay, the bacteria will be strained out. There are certain diseases, however, the germs of which are so small that they pass through the finest filters. Some of these germs appear as mere points under even a powerful microscope, and many of them have not been seen at all. Most of them are like protozoa rather than bacteria, but all of them are much smaller than any bacteria or protozoa that we know and seem different from germs of these kinds. They are called *filtrable viruses*, — "filtrable" because they pass through a filter, and "viruses" because, long before the germ theory of disease was understood, physicians called that which passes from one person to another in an infectious disease the virus of the disease.

About forty diseases are now known to be caused by germs of this kind. One of them (mosaic disease of tobacco) is a plant disease. Many of them are animal diseases, hog cholera being the most important of these in our country. Among the human diseases that belong in this class are measles, smallpox, rabies, yellow fever, dengue fever, and infantile paralysis. The germs of scarlet fever, typhus fever, and trachoma probably are also of this kind, although there is some doubt about their passing through filters. We have already studied some of the best known of these diseases. Others with which we are less familiar we shall discuss at this time.

INFANTILE PARALYSIS (POLIOMYELITIS)

Infantile paralysis was first described in 1881, and since that time it has been found in nearly all parts of the world. It seems to be becoming much more widespread year by year, especially in the United States. Its onset is sudden and severe, the spinal cord and brain being especially affected, and it often leaves the patient with some part of the body paralyzed. It attacks children under five years of age especially, but older persons also may suffer from it. The germs are found in the secretions from the nose and throat, and in the wastes from the alimentary canal.

The germ of infantile paralysis. Under a microscope the germ of infantile paralysis appears like a very small coccus, but it is much smaller than any known bacterium, — only about one fourth the diameter of one of the pus-forming cocci. It can withstand considerable drying, and can cause the disease in monkeys and rabbits as well as in man.

How the germ gets into the body. There are two theories as to the way the germ of this disease gets into the body. The first is that it is carried by some biting insect, perhaps the stable fly (*Stomoxys*). One fact in support of this theory is that the disease is found in the country and in villages rather than in cities. Another fact is that it is most common during the warm months, when insects are abundant. Furthermore, it is known that the germ is in the blood, and monkeys have become infected from being bitten by flies that had previously been allowed to bite a monkey sick with the disease.

The other theory is that the disease is spread from one person to another in the secretions of the nose and mouth. It has been proved that the germs are in these secretions, and the theory therefore seems reasonable. Certainly, until our knowledge of the disease is more complete, the only sensible course is to quarantine each case carefully and to disinfect all wastes from the patient.

TYPHUS FEVER

Typhus fever is a very severe disease that was formerly known as ship fever, or jail fever, and was not clearly distinguished from typhoid fever. It has gradually disappeared from the United States, and except for occasional cases in the crowded parts of our cities, in our seaports, or on the Mexican border, it is no longer found among us. It is still common in the higher regions of Mexico and in other parts of the world.

The germ of typhus fever has not been discovered,[1] but it is known that it is in the blood, and that the disease is spread by the bite of the louse, especially the body louse. The method of preventing the disease is to destroy the vermin that carry the germs.

ROCKY MOUNTAIN FEVER

This disease is especially prevalent in the Bitter Root Valley, Montana, but it is found also in Wyoming, Idaho, Washington, and other western states. The germ is carried by ticks, and the disease is contracted from the bite of an infected tick. How the germs get into the tick is not known, but some of the ticks found in nature are carrying them. The method of preventing the dis-

[1] It has recently been reported that typhus fever is caused by a bacillus that grows in the blood.

ease is to avoid the bites of ticks and to destroy the ticks. Methods of freeing land from these pests by grazing with sheep[1] and by destroying the ticks that attach themselves to other domestic animals are rapidly being worked out.

TRACHOMA (GRANULATED LIDS)

Trachoma is a disease of the eyes that has been found to be very widespread in our country.[2] Many cases, especially in the early stages, appear to be mild, but some cases are very severe, and blindness is sometimes caused by it. It is a stubborn disease to cure, but it can be made to yield to proper medical treatment.

The germ of trachoma. Some investigators believe that trachoma is caused by the same germ that causes pink eye (page 97), — that it is a chronic form of pink eye in which the germs continue to grow in the eyes for years, forming little ulcers and scars (granules) in the linings of the lids and in the eyeball. The more commonly accepted idea is that it is caused by an undiscovered filtrable virus. The germs are in the secretions from the eyes, and trachoma is an infectious disease.

Preventing the spread of trachoma. The germs of trachoma doubtless get into the eyes from wash basins

[1] Ticks die unless they can attach themselves to an animal, and if a flock of sheep are allowed to graze over tick-infested territory, most of the ticks will attach themselves to the sheep. The oil on the wool of the sheep then coats over the small breathing pores of the tick, and 90 per cent of the ticks will be killed. Cattle, horses, and hogs are freed from ticks by spraying them with an insect-killing liquid, or by driving them through vats filled with a liquid of this kind.

[2] In some parts of the country, as many as twenty school children in a thousand have been found to be suffering with trachoma.

and towels, from the hands, and in other ways. The disease spreads through families and through schools, and a trachoma patient needs to take great care to guard the eyes of others from the germs. Any one whose eyes continue red or painful should have them examined at once by an oculist or a physician, and if he has trachoma, both for his own sake and for the sake of those about him, he should have his eyes treated. Until the patient is cured, he should not be allowed to attend school or other public gatherings where he may spread the disease.

FOOT-AND-MOUTH DISEASE

Foot-and-mouth disease attacks cattle especially, but swine, sheep, goats, and other domestic animals, as well as man, may suffer from it. The disease gets its name from the fact that in cattle infected with it, blisters and sores appear in the mouth and on the delicate skin between and above the hoofs. It is very infectious, and in Europe it has given great trouble. In the United States it has been kept under better control, but in the winter of 1914–1915 a great outbreak occurred. It is caused by a filtrable virus, and the germs are in the milk, saliva, and other secretions, as well as in the sores. They remain alive for months if kept cool and moist, but die when they are dried. The effective methods of controlling the disease consist of preventing the shipment of cattle from infected areas, killing all cattle in infected herds, and Pasteurizing milk to prevent the disease in man. It is so infectious that it never remains hidden, and by using sufficiently energetic measures it is possible to keep it under control.

FOWL TUMOR

Another animal disease that is caused by a filtrable virus is a kind of tumor in chickens. This disease has attracted much attention, because in it the cells multiply and grow in an unnatural manner, as they do in tumors and cancer in man. A small tumor that grows on the skin of the face in man is also known to be due to a virus of this kind, and some physicians have long believed that cancer is infectious and will finally prove to be a germ disease. It is most important to discover the cause of this disease; for cancer and tumors in our country are now causing nearly 75,000 deaths each year and they have increased greatly (probably 25 per cent) since 1900.

POINTS TO BE REMEMBERED

1. Some disease germs pass through the finest filters.
2. Measles, smallpox, rabies, yellow fever, and other common diseases are due to germs of this kind.
3. The germs of infantile paralysis are in the secretions from the mouth and nose and in the body wastes.
4. Cases of this disease should be carefully quarantined.
5. Typhus fever is contracted from the bite of the louse.
6. Rocky Mountain fever is contracted from the bite of a tick.
7. Cases of trachoma should be treated and quarantined.
8. Foot-and-mouth disease is a very infectious disease of cattle, which man may contract from milk.
9. Cancer may prove to be a germ disease.

CHAPTER THIRTY-SEVEN

NEW DISCOVERIES IN REGARD TO GERM DISEASES

It is now only about forty years since the germ theory of disease came to be understood, and it is wonderful that we should have learned so much about these diseases in so short a time. Our knowledge of them is still incomplete, however, and scientists are constantly studying them and the germs that cause them, and each year new discoveries in sanitation are being made. Many of these discoveries prove most valuable in the warfare against germs, and each year we learn better how to bring communicable diseases under control. In this chapter we shall study some important facts in preventive medicine that have been discovered in the last few years.

A study of tuberculosis. In 1913 in Minnesota, forty city families, in each of which a consumptive had been living for a year or more, were investigated. In every one of these families it was found that at least one other person was infected, and in ten of the families every member was infected. All together, there were in these forty families 207 persons living with consumptives, and of these 207 persons, 138 had contracted the disease. At the same time, fifteen families in which there were no consumptives were investigated, and in these families only two persons out of eighty were found to be infected. Other studies in the rural parts of Minnesota seemed to show that parts of counties where no consumptives had lived were entirely free from the disease, and that where it had been introduced into a community, it had spread to the families living on the farms close to the consumptives. It was also concluded

from these studies that the danger of infection depends on the amount of exposure to the germs; that the danger from a chance meeting with a consumptive, or from living in the house with him for a few days, is not great, but that there is great danger of infection if one lives with a consumptive for a long period of time and is exposed to great numbers of the germs day after day (page 151). This study indicates that isolating cases of tuberculosis is the most important measure in preventing the spread of tuberculosis, and in Minnesota a consumptive is required either to reside in a sanatorium or to live separate from the other members of the family in the home.

Contact infection. This study, like all the newer investigations of the subject, leads us to believe that it is not from air, dust, clothes, or furniture that germs usually reach us, but that they are passed in a rather direct way from one person to another on the hands, or on drinking cups, dishes, and other articles. This passing of germs from one person to another in large numbers and without giving them an opportunity to dry is called *contact infection*, and undoubtedly the great majority of cases of diseases like typhoid fever, pneumonia, influenza, diphtheria, whooping cough, scarlet fever, measles, and tuberculosis, originate in this way. So important indeed do some health officers now consider this method of infection, and so few cases of many diseases do they think come from houses, furniture, and clothes, that they have given up the disinfecting of houses after cases of diphtheria, measles, and scarlet fever, and are spending their energies in finding and isolating the persons who are carrying the germs.

The theory on which this practice is based is that when mucus and other matter containing germs is dried on desks, doorknobs, or other articles, the great majority of the germs die at once; that the others are weakened by the drying; and that the small number of weakened germs that one would get from articles of this kind is not dangerous like the great numbers of fresh germs that one may receive direct from the patient himself, or from something he has just handled.

Two aids in preventing contact infection. One of the most effective measures for preventing contact infection is medical inspection of schools, because where this is practised cases of infectious diseases are found in their early stages and removed before the germs spread to others.[1] Another great aid in preventing contact infection is hospitals for isolating cases of typhoid fever, pneumonia, influenza, diphtheria, and other like diseases. These hospitals can give patients suffering with such diseases better care, better nursing, and better medical attention than they receive in their homes; they can at once cut off much sickness by stopping the spread of these diseases through

FIG. 115. By medical inspection in schools, early cases of infectious diseases are discovered.

[1] One French sanitarian, in referring to the custom of disinfecting schoolrooms to stop the spread of measles, exclaimed: "The germs are in the nostrils of the children, and they disinfect the furniture!"

families; and they ought to be established in every county and town in the land.

A safe disposal of human wastes. Notwithstanding all the campaigns for sanitation that have been carried on in recent years, there are hundreds of thousands of farms in our land that are still without closets, and in villages, school grounds, church yards, and beside country homes, there are hundreds of thousands of open closets still in use. Any one who knows the habits of the housefly — how day after day it passes back and forth between these places and dining-rooms and kitchens — knows that as long as such a condition continues, not even a beginning in sanitation and hardly a beginning in civilization has been made. It cannot be too strongly insisted upon that one of the first and most important of all sanitary measures is to provide a safe means of disposing of human wastes, and a sanitary toilet arrangement should be a part of every human habitation in the land.[1]

Screening against mosquitoes. The ordinary screens that are placed on houses are fly screens, and not mosquito screens, and the meshes in them are so coarse that the mosquitoes that carry malaria and yellow fever can pass through them. To keep the malaria mosquito out

[1] Complete directions for building sanitary closets may be obtained from any State Board of Health, or from the United States Public Health Service, Washington, D.C. The Rockefeller International Sanitary Commission suggests that if nothing better can be provided, a box placed in the forest or among bushes may be turned, mouth down, over a small pit and moved from time to time. The box can be made fly-tight by banking the earth around it and covering the openings, and this is the most important point in the construction of a closet. When the box is moved, the pit should be filled with earth. It is not safe to use wastes from a closet as a fertilizer for gardens.

of a house requires a screen with about sixteen strands to the inch, and to turn the yellow fever mosquito, twenty wires to the inch are necessary. Galvanized or bronze screens will in the end prove cheaper than painted iron wire, and they permit the air to pass through them much more freely. Careful work is needed to make the screening on a house effective; for a feeding of blood is necessary to the female mosquito before she can lay her eggs, and she will search over screens until she finds the smallest crack or opening, or even come down chimneys, to get into a house. Since mosquitoes are attracted by light, lamps should be kept away from doors in the evening, and on a screened porch the lights should be placed at the other end from the door. It has been reported that ducks are most valuable in destroying the larvæ of mosquitoes, and that if ponds are kept free from the large fish that feed on minnows, the minnows will allow almost no mosquitoes to breed in the water.

Bad after-effects of infectious diseases. Recently an investigation has been made by the Metropolitan Life Insurance Company of New York, of the death rate among 1574 of its policy holders who suffered from attacks of typhoid fever in 1911. Of these 1574 persons, 146 died of the disease, and 1428 survived; but during the next three years fifty-four of these survivors died of other diseases, twenty-one of them of tuberculosis. This gave a death rate more than twice as high as was to be expected among persons of this age.[1]

[1] It is estimated that in the United States 178,200 persons survived attacks of typhoid fever in 1914, but that 7781 of these survivors will die inside of three years, because of the damage done them by the disease.

In the same way, bad after-effects follow measles, diphtheria, scarlet fever, influenza, pneumonia, and other germ diseases, and to take no account of these after-effects is like leaving out of account the wounded when one is reckoning the losses in war.

Raising the defenses of the body by vaccination. In the last few years the idea of preventing by vaccination certain diseases that are not well controlled by sanitation has gained great headway. Not only is this practised for the prevention of smallpox, rabies, and certain animal diseases, but vaccination against typhoid fever has now been proved to be a great success.[1] The same methods have been employed to check epidemics of cholera, plague, meningitis, and whooping cough; and some individuals have themselves vaccinated against colds, influenza, pneumonia, and other diseases.[2] The theory of all vaccination is the same, — weak or dead germs are introduced into the body, and this causes the germ-killing power of the body to be increased.

The prevention of plague. Plague is first of all a disease of rodents (animals like rats, mice, squirrels, prairie dogs, and rabbits), and the only way of fighting it is to fight the rats that are the principal carriers of it. Something can be done by trapping and poisoning them, but

[1] Formerly typhoid fever was the most dreaded of all camp diseases, and usually during war more soldiers died from it than from wounds. During the spring of 1911 the United States had a force of 15,000 soldiers, all vaccinated against typhoid fever, in camps in Texas, and only one case of the disease appeared among them.

[2] It is reported from Russia that epidemics of scarlet fever have been checked by vaccination against the pus-forming bacteria (streptococci) that are always present in this disease.

they multiply so rapidly that the only effective way of dealing with them is to cut off their food supply and break up their homes.[1] To do this it is necessary to keep garbage in covered cans; to rat-proof slaughter houses, mills, warehouses, and stores; to provide cement floors and rat-proof bins in livery stables and barns; and either to close rats out from under buildings and floors or to raise these enough for dogs and cats to pass freely under them. Houses should be built so that rats cannot get into cellars or walls, and all wharves should be rat-proof because of the danger of plague-infected rats landing from a vessel at any time. A campaign against rats is expensive, but it is more expensive to support an army of rats than it is to drive them out, even were there no question of health concerned.

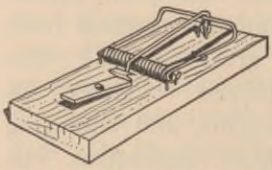


FIG. 116. The cheapest and most effective kind of rat trap.

Hookworm in dogs. It is reported that the disease called "black tongue" in dogs is caused by hookworms and that the infection among both dogs and cats is widespread. The hookworms that attack animals are different from those that infect human beings, but in general it is coming to be believed that we contract disease from animals more frequently than was formerly supposed, and that dogs and cats are not good companions for children.

[1] There are often ten or twelve rats in a litter, and a female white rat has been known to give birth to more than eighty young in a year. It is estimated that there are more rats than men sailing the seas; that in cities there are as many rats as people; and that in the country there is one rat to each acre of land. In California, plague spread from the rats to the ground squirrels in the country and was eradicated only at great expense.

Controlling epidemics of measles in schools. Because the first symptoms of measles resemble a cold and the disease is often not recognized in its early stages; because it is highly infectious in these first stages; because cases of the disease are so mild that they are overlooked; because the germs are so powerful that they can successfully attack almost every one they can reach; and because its victims are chiefly small children,[1] measles is a most difficult disease to control. One useful plan in schools is as follows: When a pupil is attacked, the school is continued as usual for about eight days. Then the children who were exposed to the disease are kept out of school for a week. After this, all those who have not developed the disease or are not being exposed to it at home are allowed to return (page 132).

A disease that has been confused with tuberculosis. Recent investigations prove that a number of cases of supposed tuberculosis are not due to the tubercle bacillus, but to a threadlike fungus (*Nocardia*). It is not known how common this disease is, but it requires different treatment from tuberculosis, and it is important that it be distinguished from tuberculosis.

A disease of the teeth caused by an ameba. A certain long-continued and stubborn disease of the teeth (*Rigg's disease*, or *pyorrhea*) has been found to be due, in part at least, to an ameba (page 210). This large germ, along

[1] Diseases that attack small children do not receive the same attention as diseases that attack prominent citizens in the midst of their careers. The prevention of measles has, therefore, been neglected, and we have in our country during some years more than 1,000,000 cases with more than 10,000 deaths.

with pus-forming bacteria, lives about the roots of the teeth and often causes them to become so loose in their sockets that it is necessary to remove them. A preparation of ipecac (*emetin*) that is used in treating chronic dysentery is reported to kill the amebæ in this disease

FIG. 117. Isolation hospital for cases of infectious diseases at Jacksonville, Florida. To prevent the spreading of germs within the hospital, the water faucets and doors are arranged so that they may be opened with the elbows. The windows are covered with full length screens to keep out flies and mosquitoes, but there is no fear that the germs will travel through the air and visitors are allowed to talk to patients through the windows.

also, and is said to be of great value in the treatment of the disease.

Pellagra. Several thousand cases of pellagra are now reported in the United States each year, most of them being in the southern part of the country. This disease has been supposed to be due to eating spoiled corn; to a lack of meat, milk, eggs, and other nourishing food; to the presence of too much of certain minerals in vegetables or in water; to a germ that is spread by the bite of a gnat; and to an unknown germ that is spread in communities where there is a lack of proper sanitation. Certain studies recently made seem to prove that it does

not spread in towns that have water supplies and good sewerage systems, but that it increases where open closets are found. It is probably a germ disease, but a good diet may be of importance in strengthening the body against the germs.

POINTS TO BE REMEMBERED

1. Recent studies indicate that most cases of tuberculosis come from living with consumptives.
2. Contact infection is supposed to be the principal method of spreading germs.
3. Hospitals and medical inspection of schools aid greatly in preventing contact infection.
4. Sanitary toilet arrangements should be a part of every human habitation.
5. Fine screens are required to keep out mosquitoes.
6. Many persons die because of the after-effects of infectious diseases.
7. The defenses of the body against many germs may be raised by vaccination.
8. Plague can be controlled only by fighting rats.
9. Some supposed cases of tuberculosis are due to a fungus.
10. A disease of the teeth is caused by an ameba.
11. Pellagra is probably an infectious disease.

GLOSSARY

This glossary is intended chiefly to help the pupil in the pronunciation of the more difficult terms. A few words are defined. The numbers refer to pages on which will be found text that will help to make clear the meanings of the terms.

ameba (a-mē'ba), Fig. 89; *a rather large protozoön that has no cell wall about it, changes its shape, and takes in its food in the same way as a white blood corpuscle engulfs bacteria* (Fig. 9), 207.

anemia (a-nē'mi-a), 138.

Anopheles (a-nŏf'ĕ-lēz), 111.

appendicitis (ap-pen-dī-sī'tis).

bacillus (ba-sĭl'lŭs), 18, 19.

bacterium (băk-tē'ri-ŭm), 6.

bronchial (brŏng'ki-al).

bronchitis (brŏng-kī'tis).

cerebro-spinal (sĕr'e-brō-spī'nal).

coccus (kŏk'kŭs), 18, 19.

communicable (com-mu'ni-ca-ble) disease, *a disease that can be contracted by one person from another.*

corpuscle (kor'pŭsl), 11, 12.

Culex (kū'lex), 112.

dengue (dĕn'gā), 110, 194.

diphtheria (dĭf-thē'ri-a).

disinfectant (dis-in-fĕct'ant), 159.

dysentery (dĭs'en-tĕr-y), *an intestinal disease in which there is a bloody discharge from the bowels.*

emetin (ĕm'ĕt-ĭn), 208.

epidemic (ĕp-ĭ-dĕm'ĭk) disease, *a disease that people catch from one another very easily and which many people have at once. An outbreak of a communicable disease.*

esophagus (e-sof'a-gus), 75.

gangrene (găng'grēn), *inflammation that goes on until part of the tissue is dead.*

germ (jerm), *a bacterium or a protozoön that can cause disease.*

germicidal (jer-mĭ-sī'dal), *germ-killing*, 13.

infected (in-fĕkt'ed), *containing germs, as an infected wound.*

infectious (in-fĕk'shŭs) disease, *a disease, the germs of which can be passed from one person to another.*

larva (lar'va), 110.

larynx (lăr'ĭnks), 33.

lysol (lī'sōl), 160.

meningitis (mĕn-ĭn-jī'tis).

miasma (mī-ăz'ma), 105.

microbe (mī'krōb), *a living thing so small that it can be seen only through a microscope.*

Nocardia (nō-kar'dē-a), 207.

pellagra (pĕ-lăg'ra or pĕ-lah'gra), 208.

pharynx (făr'ĭnks), 33.

phosphorescent(fŏs-fo-rĕs'ent),101.

poliomyelitis (pŏl-ĭ-ō-mī-ĕ-lī'tĭs), 195.

proboscis (pro-bŏs'is), 104.

protozoön (prō-tō-zō'ŏn), 6.

ptomaine (tō'ma-ĭn), 82.

pupa (pū'pa), 110.

pus (pŭs), 24.

pyorrhea (pī-ō-rē'a), 207.

rabies (rā'bĭ-ēz).

sanatorium (săn-a-tō′ri-um), *a place where people go to regain health: a hospital for the treatment of patients who can be cured.*
serum (sē′rum), 40.
spirillum (spī-rĭl′lum), 18, 19.
sputum (spū′tum), *matter coughed up from the lungs and air passages.*
stegomyia (stĕg-ō-mī′ya), 115.
stomoxys (stō-mŏk′sĭs), 195.
tetanus (tĕt′a-nŭs).
tonsillitis (tŏn-sĭl-lī′tis), *inflammation of the tonsils.*
trachea (trā′ke-a), 33, 34.
trachoma (trā-kō′ma), 197.
tuberculosis (tū-ber-kū-lō′sis), 53.
tuberculous (tū-ber′kū-lus), *infected with the germs of tuberculosis.*
virulent (vĭr′u-lent), *powerful in producing disease.*
virus (vī′rŭs), 194.

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A star (*) indicates an illustration.