GENERAL HYGIENE

By THOMAS A. STOREY

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PART ONE

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THE AGENTS THAT INJURE HEALTH

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Part One of a Publication on General Hygiene

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PART ONE

THE AGENTS THAT INJURE HEALTH
INTRODUCTORY

Whether you know it or not, you young men of the City College are training yourselves poorly or effectively for the life that you are to lead. Every boy and every girl in this country is training a man or a woman every day—physically, mentally, and spiritually—for the demands and for the exigencies of maturity to-morrow. This training is largely unconscious and in the majority of cases one-sided, incomplete and poor. As a result, maturity finds a vast army of our men and women unfit for the demands of life in the home or in the community, and in the service of the country for peace or for war. When we grow up, too many of us find that we are not ready. Our years of youth have been wasted and lost. Are you wasting yours?

Furthermore, whether he knows it or not, the adult human is training himself each day for the days that are to come. The child and the youth have growth and development and functional excellence to achieve. The adult must train to conserve his health or lose too rapidly as he grows older the health that he has. The training of the adult is harder or easier because of the habits of living, good or bad, that dominated his life when young. What are you doing for the man you are to be?

It is obvious that the period for intelligent direction, for wisdom, and for vision in the training for life—in the building of manhood and womanhood—is the combined period of infancy, childhood, and youth. This is your period. Are you making use of it?

The fundamentally important and tremendously large factor in this too often neglected training from infancy to old age, inclusive, is the physical training, or physical education or hygiene of the individual and of individuals in groups. This training is concerned with the acquisition and conservation of health. It is concerned with good health—a quality that is not satisfied with merely "being well."

Good health—good, active, aggressive health—is the most important thing in the world.

If you wish to learn something about the value of health, ask the man who has lost his health—go to the woman who is trying to buy back her health.
Good health—the quality of your physiology that gives you normal organic growth, normal development, and normal function; the state of body and mind that makes it harder for you to be sick and easier for you to get well; the physical condition that brings you a feeling of comfort and well-being, a resiliency and an enthusiasm for the day's work; the thing that removes the fatigue of yesterday and restores your energy for to-day—good health makes possible for you a full measure of success in your life's work, whatever that work may be.

Good health depends largely upon good health habits. Your health to-morrow depends on your habits to-day. "Yesterday is a dream and to-morrow is a vision. But to-day lived right makes of every yesterday a dream of happiness and of every morrow a vision of hope."

Health habits may be classified as: (1) Habits of information—the use of reliable literature and lectures; regular health examinations by competent health advisors. (2) Habits of bodily care—conservation of vision, teeth, etc. (3) Habits of protection—avoidance of the agents that injure health and of the carriers of disease. (4) Habits of constructive hygiene—wise habits of nourishment, adequate excretion, sufficient work, exercise and play, and satisfying rest.

The Department of Hygiene in the College of the City of New York aims to give you practical instruction leading to the formation of health habits along these several lines.

The medical examinations required here every half year enable you, while you are here, to practice habits of health examination and care of physical defects. The College is doing all it can to make these examinations useful. Their real value, however, depends upon the use you make of them now and your continuation of periodic health examinations after you leave college and become a responsible citizen.

This text and the Health Talks that we give you once or twice a week will bring to you information on the basis of which you may establish habits of protection against the causes and carriers of disease, and assist you also in the formation of wise habits of daily living.

Our required courses in physical exercise and our free provisions for recreation, play, and for athletic training, are maintained by the college in order to give you opportunities to secure more nearly your full bodily growth, organic development and functional perfection; and to make it possible for you to acquire such habits of constructive hygiene as will conserve and increase your future years of vigorous usefulness.

Remember, then, you are training a man; building a citizen; you are to-day master of the man you are to be. (1) Good, active, aggressive health is the most important thing in the world, not for its own sake.
but because the best success of whatever you undertake to do depends upon the good health with which you back up your undertaking. (2) Good health depends upon: (a) Habits of information—good, reliable literature, lectures, and demonstrations; and regular, careful, serious health examination; (b) sane common sense habits of bodily care, correction and repair; (c) vigilant but reasonable habits of health protection, and (d) wise habits of constructive hygiene—adequate nourishment, effective excretion, sufficient work, exercise, and recreation, and satisfying rest.

II

CLASSIFICATION OF THE AGENTS THAT INJURE HEALTH

We can not expect in a series of short talks such as we are giving you, to cover all the common agents that injure health. It is, furthermore, impossible for us, under these conditions, to make a thorough study of any single cause of disease. All we plan to do is to make you acquainted with the most important of these enemies of health. These agents may be classified with a fair degree of completeness as follows:

A.—Direct or Primary Causes of Health Injury

(1) Heredity. Limited to the inheritance of some morbid conditions and to increased susceptibility to certain diseases. “There is no true inheritance of infectious disease.”

(2) Mechanical agents. Pressure applied in various ways, usually accidentally, causing fractures, concussions, bruises, lacerations, etc.

(3) Physical agents. (a) Light; X-ray and other rays; electricity; (b) heat and cold; (c) atmospheric pressure.

(4) Chemical agents. (a) Inorganic poisons such as lead, arsenic, mercury and phosphorus; (b) organic poisons such as alcohol, opium, cocaine; food poisons such as physiological poisons in shell-fish and mushrooms; and some of the products of decomposition of animal and vegetable matter.

(5) The vegetable parasites known as “bacteria.” They cause such diseases as typhoid fever, relapsing fever, diphtheria, whooping-cough, epidemic cerebro-spinal meningitis, erysipelas, lobar pneumonia, acute rheumatism, Asiatic cholera, plague, bacillary dysentery.
Malta fever, anthrax, glanders, tetanus, gonococcus infection, leprosy and tuberculosis.

(6) Vegetable parasites other than bacteria. Actinomycosis, oidomocosis, mycosis, etc.

(7) Protozoa or unicellular animal organisms. (a) Malaria; (b) typanosomiasis or sleeping sickness, caused by a trypanosome; (c) amebic dysentery; (d) syphilis, caused by the treponema pallidum.

(8) Multicellular animal parasites or metazoa (worms and insects principally). (a) Fluke worms; (b) tapeworms; (c) round worms such as hookworm, pinworm, trichenella spiralis, various filaria; (d) leeches; (e) tongue worms; (f) acarines.

B.—The Indirect or Contributory Causes of Poor Health

The contributory causes of poor health are those influences that make it easier for human beings to become sick or harder for them to get well. They include:

(1) Those influences that favor the production, distribution or vitality of the specific causes or carriers of disease.

(2) Those influences that tend to interfere with or break down our environmental defenses against poor health and disease.

(3) Those influences that tend to weaken or destroy our bodily (anatomical and physiological) defenses against disease.

The following may be cited as examples of contributory causes of poor health: (The subject will be covered another term.)

(1) These influences may exist in the environment, e.g., excessive fog; excess of moisture in the air or soil; high and low temperatures; excess of or lack of sunshine; warm, dry and stagnant air; air contaminations; noise.

(2) These influences may be physiological, e.g., age; sex.

(3) They may reside in abnormal bodily conditions, e.g., heredity; defective vision; obstructed breathing; decayed, unclean teeth and sore gums; flat feet; curved spine, flat chest; obesity, emaciation; chronic disease; after-affects of acute disease; affects of trauma (gross injuries, injuries from dust, irritating vapors, gases, chemicals).

(4) They may be connected with insufficient bodily nourishment, e.g., insufficient food; poor food; bad habits of eating; insufficient air; insufficient water.

(5) Interference with excretion may be a contributory cause of disease, e.g., by way of the respiratory tract, the genito-urinary tract, the skin or the bowels.

(6) Interference with special functional activities may contribute to
the production of disease, e.g., through the lack of physical exercise, or through nervous excitement, worry, apprehension, fear or depression, or through lack of sleep.

Remember: That the indirect or contributory causes of poor health are those influences which tend to make it easier for you to be sick and harder for you to get well. The exciting causes of poor health act more certainly and more injuriously when the contributory causes have prepared the way.

III

THE HYGIENE OF HEREDITY

The vehicle of inheritance. (a) All living things—plants or animals—are produced by the union of two germ cells (parent cells), or they are produced by the division of a single parent cell. (b) The nucleus of the parent cell is the vehicle of inheritance. The problems of inheritance are problems of the nucleus of the germ cell.

The inheritance of disease and the inheritance of tendencies to become diseased are limited to those morbid conditions in the parent which may affect the quality of the nucleus of the parental germ cell.

Examples of racial hereditary disease. (a) White races are more susceptible to yellow fever than other races. (b) The negroes, to sleeping sickness. (c) The negroes and American Indians to tuberculosis. (d) Gout is more common to the English, obesity to the Dutch, and obesity and diabetes to the Jews.

Examples of family hereditary disease. (a) Reappearance of identical diseases—gout. (b) Appearance of related diseases—obesity, rheumatism, gout. (c) Inheritance through father—gout. (d) Inheritance through mother—hemophilia. (e) Family tendencies to infectious disease—a lack of resistance to tuberculosis, acute rheumatism, measles, scarlet fever, etc. (f) Constitutional or nutritional diseases, tendencies to gout, rheumatism and diabetes. (g) Nervous diseases and tendencies to nervous diseases. The most common type of hereditary manifestation of disease. Hysteria, migraine, epilepsy, various convulsive affections, various paralyses, certain atrophies, and various forms of mental abnormality, including idiocy, imbecility and insanity.

The possibility of there being such a thing as the inheritance of acquired injury. (a) No such thing as inheritance of gross mutilations; nor transmission of maternal impressions; nor inheritance of training or lack of training; nor inheritance of infectious disease. (b) Poisons cir-
culating in the blood may injure the germ cells directly or indirectly through injury of other organs so that these injuries may result in the production of damaged offspring. Alcohol may lead to sterility, early death of infant, or to mental, moral or physical weakness of offspring. Lead poisoning and poisoning with nitrate of mercury have same influence as alcohol. Bacterial poisons may be in same class. (c) Severe constitutional disease is known to have a profound influence on the germ cells, producing sterility, death of infant, production of weaklings, and imperfections in later generations.

Syphilis is an example of a constitutional affection having seriously important influence on heredity. The infection itself is not inherited. The infection may be transmitted congenitally. The constitutional affects of the disease may offer severe injury to the germ cell, causing sterility, death of the unborn or newly born child, or weakness, incapacity and uselessness in the living offspring.

Your health problems of heredity are: (a) The health problems resulting from your heredity, and (b) the health problems which you transmit. You have some control over (a) and you have a large control over (b).

Community, hygiene and heredity. (a) Alcoholism, venereal disease, industrial disease, etc., in their possible relation to the emphasis, initiation and transmission of hereditary diseases are serious community problems. (b) The relation of pauperism, mental degeneracy and crime to heredity justifies community interference with the initiation and perpetuation of such heredity. (c) The fact that war destroys the fit and leaves the unfit and the less fit to dominate posterity is a matter deserving the most serious concern of all society. (d) Field of eugenics.

IV

PROBLEMS OF HEALTH AND DISEASE THAT ARISE DURING THE PERNAL PERIOD

Every human being is the product of the union of two germ cells, a maternal germ cell and a paternal germ cell.

The union of these two parental germ cells forms a single cell which is called the fertilized ovum.

This single cell contains all the heredity and all the possibilities which the parental stock is able to contribute.

Rapidly this single cell divides into two cells; these two into four; the four into eight; the eight into sixteen; and so through a process
of multiplication by two the single cell becomes hundreds, thousands, and thousands of millions of living tissue cells. For a prenatal period of about 287 days these living cells are multiplying, organizing, adjusting and developing into a human form, a human structure, a human being.

During this prenatal period, the growing human embryo may be injured or diseased through serious injury, disease or poor health of the mother. This injury may be accomplished by overwork of the mother, rough treatment or insufficient nourishment of the mother, leading to weak, puny or non-resistant offspring, or even to the birth of a dead infant. Heart disease, kidney disease, syphilis, and other diseases of similar importance may bring about these results.

Alcoholic women, and women who work in lead and with nitrate of mercury may be unable to bear live children; or lose them soon after birth; and may bear idiots, imbeciles and epileptics.

Poisons like alcohol, lead, mercury, arsenic, carbon monoxide and morphine easily pass from the circulation of the mother to that of the unborn child.

Infectious diseases do not often pass from the mother to the fetus, but such transmissions do occur. There are recorded cases of fetal infection with syphilis, tuberculosis, smallpox, chickenpox, measles, scarlet fever, erysipelas, septic disorders, acute rheumatism, typhoid fever, cholera, cerebro-spinal meningitis, influenza, mumps, relapsing fever, malaria and yellow fever. The list is a long one but the number of cases on record is small. (Adami.)

The influences that may lead to injury of the unborn infant as described above may be classified as: (a) Physical or mechanical; (b) nutritional; (c) toxic; (d) infectious.

Problems of Health that Arise at Child-birth

Child-birth not infrequently exposes the infant to physical or mechanical injury, or to contact infection. It occasionally happens that the life of the infant must be sacrificed in order to save that of the mother. This situation is rare and is usually the result of natural interferences with the normal delivery of the child. More commonly it is necessary for the physician to assist the birth by manual or instrumental measures. These procedures save many lives, both of mothers and infants, but they are occasionally accompanied by physical injuries of more or less serious importance to the mother and to the child.

The most common and the most serious infection of infants at this
time is gonorrhea. Less common infections are from various pus organisms. Gonorrhea in the new born is usually located in the eyes. Fortunately, this serious infection is becoming less common, but it is probably even yet fair to state that more infants are made blind in this than in any other way. Thus the infant suffers because of the careless hygiene of its parents. A disease of shame and sin so far as the parents are concerned, and a disease of careless uncleanness so far as the child is concerned.

SUMMARY

The prenatal period and the period of birth are, then, periods in which the hygiene of human life requires special forethought and care. The overworked mother, the underfed mother, the sick mother, must necessarily fail to protect and to nourish her unborn babe adequately. Responsibility for such failure must rest upon the father quite as much as the mother. This responsibility is often a responsibility of society itself. The community regulation of women's work is of great importance in those occupations which stamp their damage upon the power of motherhood and on the vitality of offspring.

It must be obvious, too, that the unborn babe and the babe at birth are often made to suffer in punishment for the unhygienic habits of either or both parents. The various infections, particularly those of syphilis and gonorrhea, figure especially in events of this sort.

V

THE MECHANICAL AGENTS THAT INJURE HEALTH

The mechanical causes of injury, poor health and disease, are the common factors that give serious importance to most of the accidents that happen to human beings.

These mechanical causes of injury are classified by Adami as follows: (a) Concussion. (b) Puncture, with which may be included the influence of projectiles under high velocity. (c) Section. (d) Contusion, with which may be included lacerations and tearing. (e) Compression. (f) Distension. (g) Atmospheric pressure.

These influences operate most commonly in the accidents that occur in traffic and transportation and in our various industrial enterprises, such as railroads, mines. metallurgical plants, factories and construction works. In 1919 there were 2,000,000 individuals among the 40,000,000 industrial workers in the United States who lost working time because of
accidental injuries. Of this number, 22,500 were killed. The total loss in working time amounted to more than 18,000,000 man-days per year. Over 15,000 suffered permanent disability.

Drowning may be classed as mechanical injury to human life. There were in 1921, in the area of registration, 6,489 deaths from accidental drowning. This is a very strong argument in favor of a swimming requirement. (The area of registration contains 85 per cent. of the population of the United States.)

Murder and suicide are commonly effected by mechanical means though not infrequently chemical. Reports from the registration area containing 85 per cent. of the total population of the United States indicate that in 1921 there were in this area 11,136 suicides and 7,545 homicides.

During its first five months, the Great War was responsible for the loss of more than two million human lives. The gross direct injuries of war are largely mechanical. Estimates made in 1919 place the number above 9,000,000. (War has a powerful contributory influence on communicable disease, an emphasis on hereditary degeneracies, and a destructive effect on community morals, not to be confused with the direct mechanical effect of powder and ball.)

Mechanical injury figures largely in the affairs of every community through all divisions of the population. The laborer is most often affected, but accidents involving mechanical injury of varying degree of seriousness are common to all classes.

Mechanical injuries are in a very large degree preventable. Safety appliances are being adopted commonly in our industrial plants. "Better safe than sorry," is the motto of many a "Safety First" campaign in our larger communities. It is a good motto for individual guidance. If half these injurious and fatal accidents could be avoided each year, the saving in human life, human suffering and human misery would be enormous.

What have you done to protect yourself from mechanical injury? Have you the muscle and the nerve to control a runaway horse? Could you save your life by climbing down a rope fire-escape? Can you jump quickly enough and far enough to avoid an automobile? Can you run fast enough to get out of the way? Could you run long enough? Could you escape from a sinking boat? A hundred feet from shore? A half mile? Can you swim? What are you prepared to do to defend yourself and your country from the mechanical injuries of war?
VI

THE PHYSICAL AGENTS THAT INJURE HEALTH

The physical agents that injure health may be classified as follows: (a) Atmospheric pressure, diminished pressure, excessive pressure; (b) temperature, low temperature, high temperature; (c) light, insufficient light, excessive light; (d) the X-ray; (e) radium; (f) electricity, lighting, commercial electricity.

Variations in atmospheric pressure are not of much importance in the affairs of the ordinary individual. Those who climb high mountains or make balloon ascensions to great heights may suffer with giddiness, rapid breathing, rapid heart rate, nose-bleed, weakness and exhaustion. These are effects of low atmospheric pressure. They are symptoms due to an insufficient supply of oxygen in the blood. Men that work in caissons, building tunnels under rivers, for instance, suffer from the effects of high air pressure. The laborer who returns from such work to normal air pressure too rapidly suffers excruciating pain, and, in some cases, death. The excessive air pressure forces the blood to take on an increased amount of oxygen, nitrogen and carbon dioxide gas. When the excessive pressure is reduced suddenly, it seems that the blood is unable to get rid of its increased amount of nitrogen as rapidly as it does the other gases it has taken up. The bubbles of nitrogen remaining in the blood cause the pain and fatality.

Variations in temperature are of importance in temperate and arctic zones.

Low temperature causes chilblains, frost bites and freezing, none of which are common or of much importance in this part of the world. In colder climates they are of more serious concern. Six persons froze to death in New York City in the winter of 1916. Three hundred and fifty-four persons died of excessive cold in the area of registration in 1918. In 1921 the number of deaths from excessive cold was 111.

Cold may lower the temperature of the body and thus reduce its resistance to disease.

High temperature may cause: (1) Heat stroke—a result of hot, moist weather—may be headache, rapid pulse, rapid respiration, loss of consciousness, death. In 1921, area of registration, there were 946 deaths from effects of heat. (2) Burns; may vary in degree from simple redness to cremation. Death follows if half the body is burned enough to cause blisters. Death follows if from one-sixth to one-eighth of the skin surface is destroyed by burning. Burned areas are easily infected. The septic wounds that occur in such areas are often
very serious. The scars that follow burns may cause incapacitating deformities. In the area of registration (1921) there were 5,329 persons accidentally burned to death; in addition, 928 lost their lives in conflagrations. In New York City in 1916, 428 persons were fatally burned.

*Light* as a source of injury to health. Insufficient light; not a specific cause of disease; may contribute to produce, or help produce poor health. A factor in causing eye strain.

Excess of light, particularly sunlight. The red rays of the sun produce heat. They are factors in heat stroke referred to above. The violet rays and the ultra-violet rays of the sun are of special importance. They may cause sunstroke when the rays of the sun fall directly on the head and neck. The symptoms of sunstroke are pains in the head and neck, nervous excitement, convulsions and loss of consciousness. Death may come in an hour. In the summer of 1916, fifty-eight persons in New York City died of sunstroke. Milder cases recover, but they frequently develop a permanent nervous disorder of some sort. These rays (violet and ultra-violet) cause sunburn. Severe sunburn is very painful. The burned area may easily become infected.

The *X-ray* and *radium rays* are sometimes causes of disease among the specialists who use them or work with them. These rays may cause sterility in the men and women. They sometimes cause “burns” that develop into cancerous growths.

*Electricity* as a physical cause of injury. Lightning may cause death or prolonged unconsciousness. Burns from lightning heal very slowly. Commercial electricity used for service and for industrial purposes is frequently the cause of injury. The seriousness of this injury depends on the amount of current that passes through the victim; the area of contact, and the region affected. Currents of low voltage and moderate frequency may be fatal if the heart is in the circuit. The electric current may cause nervous disturbances, burns, loss of vision and death. Seven hundred and forty-one deaths were reported from electricity (lightning excluded) in 1921 in the area of registration. Four hundred and sixty-one were reported due to lightning. It not infrequently happens that the heart continues to beat after breathing has been stopped by the electric current. In such cases the use of artificial respiration may save the victim from dying. (The best method of artificial respiration is the Schafer or the prone pressure method.) One should never handle loose electric wires, switches, unless he is certain of their safety and of his own protection. Carelessness has often lead to fatality.
VII

THE CHEMICAL AGENTS THAT INJURE HEALTH

Acute poisoning not included in this discussion. It may be noted, however, that there were 1,538 deaths reported in the area of registration from acute acid poisoning in 1915. Chemical agents may exist in solid, liquor, or gaseous forms. They may be either inorganic chemicals or organic chemicals.

The Inorganic Chemicals that Injure Health

Lead.—The cause of chronic lead poisoning.

Source.—Poisoning from lead is common in those industries in which lead is handled, e.g., lead mining and smelting, zinc smelting, working in lead and lead colors, making lead pipes and various other lead objects, making pottery and earthenware, type making, working in electric storage battery factories, and installing gas and water pipes.

Susceptibility.—Increased by bad habits, lack of condition, chronic illness.

Mode of Entrance.—Skin absorption plays a part. Inhalation of vapor of lead is a "questionable occurrence." Ingestion into the stomach is the important route.

Symptoms.—Varied and inconstant. May be colic, paralysis, convulsions, delirium and death. One hundred and forty-two deaths from chronic poisoning are reported for the area of registration in 1921. Most cases recover. (For effects on offspring see chapter on "Inheritance" and the "Prenatal Period").

Avoidance.—Poisoning by lead is avoidable through habits of cleanliness. Lead workers should wear gloves when practicable; always wash their hands before eating; never put their fingers in their mouths; omit smoking while hands are smeared with lead compositions; exercise care that their food is not contaminated with lead.

Arsenic.—The cause of chronic arsenical poisoning. Importance has greatly decreased in recent years. Source of poisoning from arsenic is now limited to arsenical beer (England); a few industrial occupations; criminal usage; and the therapeutic use of the drug (Edsall). Massachusetts law in 1900 limited the amount of arsenic to be used in coloring paper and articles of dress. Country is now almost free of poisoning from this source.

Mode of Entrance.—Inhalation; external application; ingestion.

Mercury.—The cause of chronic mercurial poisoning. Importance has greatly decreased since greater care is being used in administering
mercury medically, and since mercury is now less commonly used industrially. Chief sources of mercury poisoning now are mercury mining and smelting, manufacturing of thermometers and barometers, and the manufacture of felt hats.

Mode of Entrance.—Inhalation of vapor, the chief avenue of entry. Absorption through the skin also important. Ingestion not common.

Symptoms.—Chiefly mental, nervous and digestive. Recovery probable in mild cases. (For effect on offspring see chapters on "Inheritance" and the "Prenatal Period").

Phosphorus.—The cause of chronic phosphorus poisoning. The importance of phosphorus poisoning has greatly decreased in recent years because of stringent laws and improved methods of manufacture. Chief source is the white phosphorus used in making matches.

Mode of Entrance.—Ingestion. Symptoms may be severe. Necrosis of the bones of the jaws is the most common local symptom. This necrosis reaches the surrounding tissues and may become extensive. Foul odor, repulsive appearance, deformity, and death are not uncommon effects of the disease.

Prevention.—Stop using white phosphorus. Keep the mouths of working people clean.

Carbon Monoxide.—Importance is increasing because of the opportunities for acute and chronic poisoning from the automobile exhaust and from various industrial sources.

Sources.—Pure carbon monoxide (from electric furnaces) illuminating gas; product of gasoline combustion in automobiles.

Mode of Entrance.—Inhalation. Symptoms arise from injuries to the blood, kidneys and brain. Three hundred and forty-five persons lost their lives from illuminating gas in New York City in 1916.

The Great War has produced some new poisonous chemicals of terrible power. The gases used in offensive warfare include chlorine, phosgene, xylil bromid or benzyl bromid, phenzl carbylamin chlorid, diphenyl-chloroarsin, dichloro-diethzlsulphid. Used as gas clouds, in gas bombs, and in gas shells. Protective devices have been produced for all these gases.

The manufacture of high explosives is accompanied by danger to the workmen because of the poisonous properties of some of the chemicals used. Among the most dangerous in this class are picric acid, trinitrotoluol, and the fulminate of mercury.
The most important organic chemical poisons that may be placed in this group are alcohol, opium, morphine, cocaine, various food poisons, snake and other venoms and the organic chemical poisons that cause the auto-intoxications. (This discussion is based largely on the facts presented in Osler's Modern Medicine, Vol. 1, Part IV.)

**Alcohol.**—Varieties of alcohol. Methyl alcohol, known as wood alcohol, is used to adulterate cheap whiskies. Very dangerous. Ethyl alcohol, main factor in alcoholic drinks. The higher alcohols (Fusel oil). Relation to acute or chronic alcoholism probably unimportant.

**Sources of Alcohol (Ethyl).**—Certain patent medicines contain from 6 per cent. to 47½ per cent. alcohol. The public uses large amounts of patent medicines. Many persons acquire the habit of using alcoholic drinks in this manner. Physicians' prescriptions not infrequently contain alcohol. The bar-room, the restaurant and the drug-store are the common sources from which alcohol may be secured in one form or another.

**Effects of Alcohol.**—Between 1895 and 1905 there were admitted to the alcoholic wards of the Bellevue Hospital 43,916 men and 16,076 women. The statistics from many institutions show that from 20 to 75 per cent. of these alcoholics have had either an alcoholic father or mother or both parents given to such excesses. (Lambert.)

**Acute Poisoning** with ethyl alcohol (ordinary intoxication) may cause death. In 1915 there were 2,945 deaths reported from alcoholism. In 1921, there were 1,611 deaths reported.

**Chronic Poisoning.**—The habitual use of alcohol is known to produce the following effects upon men and women: It causes the muscles of the heart to become degenerated and weak. This is not infrequently the cause of premature death. The blood vessels (arteries) often become hardened and therefore liable to break. Hardened arteries are factors in causing the symptoms of old age. A broken artery means a hemorrhage. If the artery is large, death follows. If the artery is in the brain, death or paralysis follows. The liver may become diseased. This is not uncommonly the basis for a general disability, finally ending in death. The stomach is usually badly treated by the alcoholic. He suffers from indigestion which is sometimes most severe. Chronic alcoholism sooner or later injures the kidneys. Since the kidneys are the most important excretory organs in the body, such injury is serious.
Chronic alcoholism often causes sterility in women and impotence in men. The brain may be affected, leading to delirium tremens and hallucinations, and to homicidal and suicidal tendencies. The nerves may be paralyzed. The general resistance of the individual is reduced so that he gets sick more easily and recovers with more difficulty. The mortality of alcoholics with pneumonia is twice that of non-alcoholics. The chemical and physical agents that cause disease are more injurious to the alcoholic than to the non-alcoholic. The children of alcoholic mothers have 2.5 times the mortality of those of non-alcoholic mothers. They are often still-born, and if they do live are weak and non-resistant. The children of alcoholic parents are often epileptic, idiotic or weak-minded. The alcoholic is of weak will and blunted moral sense. He is unclean, untidy, and often filthy. He loses his sense of shame, his feeling of domestic or community obligation, and his love for those that should be near and dear. The drunken father and the drunken mother are destroying themselves physically, mentally and morally while they are transmitting their mental and moral weaknesses to their children through heredity and through example.

The Mortality Bill Against Alcohol (Life Extension Institute's Monthly Letter, Number 12): “In a number of life insurance companies, chiefly in Great Britain, the abstainers were separated from the rest of the policyholders (all accepted as temperate and healthy risks), and the difference in the death-rate determined. In the United Kingdom Temperance and General Provident Institution of London over a period of forty-five years the mortality of the non-abstainers, or so-called moderate drinkers, accepted as temperate and healthy risks was 37 per cent. higher than that among the total abstainers. In the Sceptre Life Association of London over a period of twenty-seven years the mortality of the non-abstainers was 54 per cent. higher than among the total abstainers. In the Scottish Temperance Life Assurance Co. of Glasgow, over a period of twenty-nine years, the mortality of the non-abstainers was 44 per cent. higher than among abstainers. In the Manufacturers’ Life Insurance Co. of Canada over a period of eight years the mortality of the non-abstainers accepted as temperate and healthy risks was 78 per cent. higher than among the abstainers. There has recently been compiled the experience of forty-three American life insurance companies extending over a period of twenty-five years. The death-rate among certain types of drinkers was compared with that among insurance risks generally. The results follow, supporting the evidence derived from British companies: First, those who were accepted as standard risks but who gave a history of occasional alcoholic excess in the past. The mortality in this group was 50 per cent. in
excess of the standard mortality, equivalent to a reduction of over four years in the average lifetime of the group. Second, individuals who took two glasses of beer, or a glass of whiskey, or their alcoholic equivalent, each day. In this group the mortality was 18 per cent. in excess of the standard. Third, men who indulge more freely than the proceeding group, but who were considered temperate and acceptable as standard insurance risks. In this group the mortality was 86 per cent. in excess of the standard. In short, we find among alcohol users the following increases of mortality over the standard or average death-rate among insured risks generally:

\[
\text{Death-rate in Excess of Standard}
\]

<table>
<thead>
<tr>
<th>Category</th>
<th>Death-rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady moderate drinkers, but accepted as standard risks</td>
<td>86 per cent.</td>
</tr>
<tr>
<td>Having past excesses</td>
<td>50 &quot; &quot;</td>
</tr>
<tr>
<td>Very moderate drinkers</td>
<td>18 &quot; &quot;</td>
</tr>
</tbody>
</table>

"This means that steady drinkers who exceed two glasses of beer or one glass of whiskey daily should be charged a heavy extra premium, and that there is a distinct extra hazard even on those who drink to a lesser degree. In these groups, the death-rates from Bright’s disease, pneumonia and suicide were higher than the normal. Unfortunately, in the investigation of American companies, no comparison was made with total abstainers. It is evident, however, from the trend of the figures and the results shown by British companies, that such a comparison would show the abstainers to have a long lead in vitality over the very moderate drinkers."

**Prevention.**—Many books are written on alcoholism and its prevention. This is a matter of personal and community concern. You must avoid such habits yourself and you must use your influence as a voting citizen to protect your family and your community from this influence.

IX

ORGANIC CHEMICAL AGENTS THAT INJURE HEALTH

—Continued

*Opium and Its Derivatives.*—In this group are opium, morphine, codein, heroin and other lesser important drugs.

These organic chemicals, called alkaloids, are secured through direct purchase, physicians’ prescriptions, or in patent medicine. Opium may be smoked. It and the other derived drugs are more commonly taken by mouth or hypodermically. Laws are formulated in many States to
restrict the sale of such drugs. We have also a Federal law to this
same effect. Medical teaching nowadays is directed against such use
of these drugs as may lead to habit formation. These drugs cause
acute poisoning if taken in any but small doses. Death may easily
follow. They are taken by unfortunate human beings who have formed
a habit of using them. At first, small doses produce a cessation of
pain, and sleep. The habit is easily formed. After a while it takes
more and more of the drug to produce the desired effects. Very un-
derirable effects soon appear. With the smoker of opium the will is
weakened. There is loss of memory, despondency, suicidal tendency,
general tremor, a deathly pallor, failing eyesight, rapid pulse, chronic
bronchitis, indigestion, constipation, itching skin and often vomiting.
With those who take opium by mouth there is finally a degeneration
of mind, morals and physique. There is a loss of self-respect, with
insomnia, emaciation and a tendency to melancholia, dementia and
sudden death. With those who take morphine by mouth or the hypo-
dermic, there are three stages of the disease: Exaltation, intoxication,
and emaciation. The habitue ends by loss of character, will and
mores. He is beset with nightmares. His hair falls out; his teeth
decay; his face is drawn and aged. Emaciation becomes extreme. A
continual delirium may ensue and death ends the habit. The habitual
use of morphine and its derivatives is very difficult to break. It is
better never to know what drugs you are taking when you are sick.
Leave that to your doctor. If you are in pain, don’t hunt for relief
through drugs. Stick it out as long as you can. Get a good doctor
and trust him.

Cocaine.—This drug is present in certain prescriptions and patent
medicines. It is used habitually by the same type of persons that use
opium and morphine. It is taken hypodermically or by the mouth.
Very small doses sometimes cause death, the sense of sight, hearing and
smell become seriously impaired. The patient hears persecuting voices,
and sees strange, threatening objects. A delusional insanity develops.
Suicidal or homicidal impulses may appear. This drug is more quickly
and intensely destructive than alcohol or opium.—(Lambert.)

Remember: Alcohol, opium, morphine and cocaine are common
habit-forming drugs. You should take no chance leading to the forma-
tion of such habits. Look out for drinks and patent medicines con-
taining these poisons.
Tobacco.—The injuries that may result from the use of tobacco are probably of chemical origin. We possess no accurate information as to the exact nature of the chemical actions involved. The use of tobacco is often attended with such phenomena as nausea (ordinarily only in beginners); indigestion; slightly increased heart rate; moderately increased blood pressure; wakefulness; nervous irritability; lessened accuracy of muscular coordinations; increased susceptibility to fatigue; dry and irritable lining (mucous membrane) of the nose, throat, tongue and mouth; loss of vision (occasional and temporary), and acid dyspepsia.

Evidence has been produced which would seem to show that only half as many smokers as non-smokers are successful in the “tryouts” for football squads; in the case of able-bodied men, smoking is accompanied by a loss in lung capacity amounting practically to 10 per cent.; smoking is invariably associated with low scholarship (Pack, Popular Science Monthly, October, 1912).

The tobacco habit is not a clean habit. It is frequently offensive to non-users and is the basis for much bitterness on the part of such non-users. It is evidently unwise for children, young adults, and delicate, sickly, nervous, or irritable persons to use tobacco. The habitual smoker should seek regular, careful medical examination for the early detection of such injuries as have been noted above.

THE BACTERIA THAT INJURE HEALTH

Bacteria are very small plants. They are invisible to the naked eye. Some are so small as to be invisible to any but the most powerful microscopes. We have reason to believe that there may be some bacteria too small to be seen with any means now known to science.

The Non-pathogenic Bacteria.—There are two broad classes of bacteria, e.g., those that cause disease—the pathogenic bacteria—and those that do not cause disease—the non-pathogenic bacteria. Unfortunately, it seems to be true that under certain conditions non-pathogenic bacteria may become virulent, and therefore pathogenic. It is equally true, fortunately, that pathogenic bacteria sometimes lose their virulence, and thus become, temporarily at least, non-pathogenic. The
non-pathogenic bacteria exist in enormous numbers everywhere. They are far more numerous than the pathogenic bacteria. The cleanest milk you drink contains millions of them. The best city water contains them. Our surroundings, food, air and water are infected by them. But these organisms are ordinarily absolutely harmless. Many of the non-pathogenic bacteria are not only harmless in their relation to disease, but are important in their beneficial relation to health and life. In fact, all human, animal and plant life would disappear in the course of time if the valuable services of some of these bacteria should be lost.

The Importance of the Non-pathogenic Bacteria to Human, Animal and Plant Life

The "Carbon Cycle."—Carbon is essential to the life of all plants. No plant can live without it. Commonly plants secure their carbon from the carbon dioxide in the air. They "breathe" through their green leaves much as we breathe through the wall of our lungs. The plant retains the carbon and returns the oxygen to the air. The carbon is then used by the plant in building its structure. It is the chief chemical in wood. It is present in all fruits, vegetables, cereals and other vegetable foods. Animals eat the plants and thus secure the carbon which the plants have used in producing their fruits, seeds, leaves and stalks. Animals use this carbon in building their tissues, or in producing their secretions. Every tissue cell in the animal body contains carbon. Human beings eat plants, plant foods and animals. Thus the human animal secures the carbon it needs for its cells from plant life. Every cell in every tissue and every organ of your body and mine contains carbon. Carbon is absolutely essential to all life, animal or vegetable.

Whenever a plant, or an animal, or a human being discharges excretions from any of its organs, those excretions contain carbon. Some of the non-pathogenic bacteria "feed upon" those excretions and break them up into simple chemical compounds. Carbon dioxide is one of the important products of the action of bacteria upon organic excretions. Whenever a plant, or an animal, or a human dies, the non-pathogenic bacteria "feed" upon the dead body and decompose it. These thus break up the complex chemical compounds into simple chemical compounds. Carbon dioxide is always produced in such bacterial action.

The carbon dioxide released by bacteria in their decomposing influence on the dead bodies of the plant, animals and humans, and on the organic excretions, secretions, and discharges from those same
sources, passes into the air, and is again available as plant food. It may be again breathed through the green leaves of living plants and thus continue the "carbon cycle."

It is obvious that this substraction of carbon from the air, and this addition of carbon to the air must balance. If, through the course of centuries, less carbon were returned than taken out, the air would finally have too little carbon to meet the needs of plant life, and plants and animals and humans could live no longer.

The "Nitrogen Cycle."—The nitrogen cycle is very like the carbon cycle except that nearly all plants secure their nitrogen compounds from the soil through their roots. When the non-pathogenic bacteria decomposes dead human animal and plant bodies into simpler chemical compounds, they return nitrogen to the soil in simpler forms that are again available for plant life. Some bacteria take nitrogen from the air and store it in the structure of the plant in forms available for animal food.

Nitrogen is requisite for all human and animal life. Every tissue cell in our bodies must have nitrogen. If the non-pathogenic bacteria should "go out of business" there would be this second reason why all human and all animal life would disappear.

There are Other "Cycles" of lesser importance such as the "phosphorus cycle" and the "sulphur cycle." These cycles all demonstrate the fact that human life as we now know it would be impossible without the service of the non-pathogenic bacteria.

Commercial Values of the Non-pathogenic Bacteria.—Some of these bacteria give flavor to butter. Others ripen cheese. Some are important in the manufacture of vinegar, acetic acid, the tanning of hides and the curing of tobacco.

XII

PATHOGENIC BACTERIA—Continued

The Pathogenic Bacteria.—The pathogenic bacteria are the bacteria that cause disease. Our common colds, sore throat, attacks of bronchitis, are caused usually by pathogenic bacteria. Among the more common pathogenic bacteria are: The bacilli of typhoid fever, the pus cocci, the gonococci, the diplococci of meningitis, the bacilli of diphtheria, the bacilli of whooping-cough and the bacilli of tuberculosis. All bacteria, pathogenic and non-pathogenic, commonly appear in one of three forms. The cocci are round, dot-like forms, such as the pus cocci that cause boils and abscesses. A coccus may be as small as one two-hun-
dred-thousandths of an inch in diameter. The *bacilli* are longer rod-like forms such as the bacilli of typhoid fever and tuberculosis. The tubercle bacilli average about one fifty-thousandth of an inch in diameter. The *spirilla* are curved forms such as the spirillum of cholera. The spirilla are the largest of the bacteria.

Some bacteria are motile because of hair-like fringes (flagellae) which have a characteristic motion.

Some bacteria produce spores; others do not. A spore is a more resistant seed-like structure which the bacterium manufactures within its body. The spore is usually roundish and much smaller than the bacterium from which it came. More will be said about spores later. Bacteria live in dark, damp, warm and dirty places. They die in sunshine; drying kills most of them. They do not grow well in the cold. High temperatures destroy them.

Pathogenic bacteria grow best in the tissues or in the tissue juices of human beings and animals. Some pathogens will grow only in the human beings. Many pathogenic bacteria will not grow in nature. Pathogenic bacteria may remain alive for hours, days, weeks, or even months in favorable surroundings. Some bacteria die more quickly than others under such circumstances. We find tubercle bacilli in human spit. If such sputum is left in dark, damp and warm places, the bacilli in the sputum will live for a long while. Typhoid bacilli will live for a long while in cows' milk. If the milk is warm they will grow there. Pathogenic bacteria are found in the normal human throat; between the teeth; in the nose; under the eyelids; under the nails; in the creases and pores of the skin; in the intestines; in the respiratory, intestinal and genito-urinary secretions, excretions and discharges.

The Multiplication or Reproduction of Bacteria (applies to all bacteria).—Bacteria reproduce rapidly. Each bacterium grows by separating into two parts. A bacillus divides transversely so that two bacilli are formed, each about one-half as long as the original bacillus was. A coccus divides into two cocci; a spirillum into two spirilla. We call this multiplication by binary fission.

It takes a bacterium on the average about one-half hour to divide into two bacteria. Some divide in fifteen minutes; others take an hour.

If a single bacterium could be unhindered in its multiplication by binary fission, if all its descendents could multiply without restriction, it would be possible within a day and a half to increase that one single bacterium to 9,544 billions of bacteria, which would weigh fifteen thousand tons. Fortunately, conditions are never favorable for such unrestricted growth.
Some bacteria produce spores. A spore is a “seed” or “egg” which is capable of resisting influences which would destroy the bacterium which produced it. Spores are much smaller than the bacteria from which they come. A spore is much harder to destroy than the adult bacterium. It may lie a long time in a dormant condition. The spores of anthrax are said to have been found alive after thirty years of quiescence. When its surroundings are favorable, when the temperature, the humidity, and food supply are favorable, the spore begins to grow and soon becomes an active bacterium which multiplies in the usual way by binary fission. There are, then, two sorts of bacterial reproduction—one by spore formation, and the other by binary fission.

XIII

PATHOGENIC BACTERIA—Continued

The Habitat of Pathogenic Bacteria.—The bacteria that cause disease in human beings grow best in the tissues of human beings and other warm-blooded animals. Some of these pathogens will grow only in the tissues of human beings.

The bacillus of anthrax is common cause of disease in sheep and cattle. It may also cause very serious disease in careless persons who handle infected animals, or their skins or wool. The bacillus of glanders frequently causes disease in horses and cattle. The men who handle such animals are often infected. The bacillus of bovine tuberculosis causes tuberculosis in cattle. Sometimes the disease is conveyed to children through milk infected by the bovine bacillus.

There is evidence that the bacillus of avian tuberculosis (tuberculosis of birds) does not commonly cause tuberculosis in other animals; and that the bacillus of reptilian tuberculosis does not commonly cause tuberculosis in animals that are not reptiles. There are numerous other bacteria that will grow in animals but not in humans.

The tubercle bacillus that infects human beings will not infect any of the cold-blooded animals. It will cause disease in monkeys, and various other warm-blood animals. The State Department of Health has reported 13,821 cases of tuberculosis and 5,803 deaths in New York City in 1922. In 1922, in the area of registration, there were reported 90,452 deaths from tuberculosis, all forms. This would justify an estimate of over 100,000 deaths for the entire United States. The bacillus of typhoid fever caused the death of more than 8,000 people in the United States in 1922. The gonococcus makes more babies blind than any other cause.
The spirillum of cholera has been kept out of the United States for some years. It has cost this country thousands of lives and millions of dollars. It is common cause of disease in South America, European and Oriental countries. The bacillus of diphtheria infects children by preference. It may also infect puppies, kittens, horses and mice. Over 15,000 died of diphtheria in the area of registration in 1921.

Some pathogenic bacteria will grow in any of the human organs and tissues. Others seem to be limited to certain organs or tissues. The tubercle bacillus, the pus coccus and the pneumococcus (the cause of lobar pneumonia) may grow anywhere in the tissues. While the tubercle bacillus may grow in any of the organs it grows most commonly in the lungs and bones. It grows least commonly in the muscles. The pneumococcus, in the same way, grows more commonly in the lungs. The bacillus of diphtheria grows oftener on the surface of the throat and the nose than anywhere else. The diplococcus of meningitis grows best in the membranes that cover the brain and spinal cord. Other pathogenic bacteria have their "preferences" for special tissues. These facts explain why we have diseases of different organs—as diseases of the lungs, or the brain, or the bones.

Avenues Through which Bacteria Gain Access to the Tissues.—Normal healthy body tissues contain no bacteria. Most bacteria can not pass through the normal skin. Many of them can not pass through the normal mucous membranes. The mucous membranes line all the cavities of the body which are connected with the exterior. This includes the mouth, stomach, intestines, nose, eye, genito-urinary apparatus, etc.

Bacteria may enter the tissues through breaks, wounds, punctures, incisions, lacerations, abrasions and injured regions in the skin and the mucous membranes. These injuries may be microscopic—a bacterium is small—a scratch of a pin, a scratch from a finger-nail, the rubbing of a rough collar or undershirt, the bite of an insect such as the head louse, flea, bedbug, fly or mosquito—any of these may supply an opening for the entry of the pathogen. The congestion in the throat following exposure to cold or the wet may rupture small capillaries and provide an opening for bacteria. A blow on the chest, on the nose, or on the eye may give the same opportunity. Constipation may injure the mucous membrane of the intestine and supply an avenue of entry. Thus they may enter through the outer surface (skin) of the body, or being inhaled, swallowed or otherwise introduced into the respiratory, intestinal, genito-urinary or other openings in the surface of the body, they may enter through breaks in the inner surface (mucous membrane) which lines those tracts, openings and passages.
There are said to be fifty varieties of bacteria in the normal mouth; there are many bacteria under the eyelids, in the nose, in the decayed teeth, on the gums and on the tonsils. The hair of the scalp and body harbors bacteria. The skin holds them in its pores and creases. They are found on the fingers and under the nails. Some of these bacteria may be pathogenic.

Injury of any sort to the skin or mucous membrane may afford an avenue of entry for the bacteria that cause disease. This injury may be so small that it can not be seen. Bacteria are always present waiting to get in.

Conditions Modifying Infection.—After having gained access to the tissues, further growth of bacteria depends upon several conditions. First: It depends upon the virulence of the bacterium. The same variety of bacteria may in one case be extremely virulent, that is, active and strong, and in another case attenuated, that is, weak and inactive. Second: Further development depends on the number of bacteria. Within certain limitations our tissues will destroy all bacteria that reach them. Third: The avenue of infection has a marked influence. Thus, if the tubercle bacillus enters through the mucous membrane or is injected into the tissues, the usual fatal result is probable. If, however, it enters into the skin, the bacteria may be destroyed or limited to the locality in the skin to which they found entry. Fourth: Some tissues destroy all of the organisms of those diseases that reach them. Fifth: The healthy condition of the body determines its resistance. A normal healthy body will be less liable to infection than a weak, unhealthy body. The juices of a normal healthy body destroy bacteria and neutralize their poisons.

After bacteria have gained access to the tissues, the development of disease depends on: the virulence of the bacteria; the avenue of infection, and the healthy condition of the individual. Therefore, keep clean, exercise right, play and rest right, eat right, look after your excretions. In this way you will be more likely to secure healthy tissues and thus better protect yourself from disease.

XIV

PATHOGENIC BACTERIA—Continued

The Effects of Pathogenic Bacteria on Human Life.—After having established themselves in the tissues, pathogenic bacteria may cause injury in various ways. In nearly all infectious diseases the pathogenic
causes are found at one time or another in the blood. These organisms may be present in such enormous numbers as to interfere with the various seriously important functions of the blood. Remember: The blood stream brings soluble food, oxygen, water, salts and internal secretions to every one of the millions of tissue cells of the body, and it removes from these cells the waste products and secretions which come from every living cell. The bacteria in the blood may establish themselves in such large numbers at special foci in the tissues as to prevent the normal food supply reaching the tissue cells in those affected parts. Being thus robbed of their food, those cells will die, or at least be seriously injured. The presence of enormous numbers of bacteria in sensitive and delicate organs may easily cause injury by obstructing small vessels or by pressure on nerve endings. The more important and serious effects of the pathogenic bacteria are caused by their vital activities.

During the life of a great community of many billions of bacteria within the human body the following must take place: (1) These bacteria need food. They may destroy tissues and tissue products in order to satisfy their hunger. (2) Such bacteria manufacture secretions. (3) They must give off excretions. (4) They must form and give off waste products. (It is not possible to separate secretions, on the one hand, from excretions and waste products on the other, except in theory. We know that these several products exist but we can not always separate them from each other.) (5) They die and their dead bodies are dissolved by the action of the tissue fluids. (6) From these excretions, waste products, excretions and dissolved dead bodies, numerous injurious chemical substances arise. There are known to be formed in this way various poisonous acids, bases and salts, among which are a number of powerful toxic chemical substances of very great pathogenic importance. Many of these chemical bodies are known as "antigens." The toxin of the diphtheria bacillus is perhaps the best known bacterial poison. (7) All the products that go into solution are likely to be carried by the blood to all the tissue cells of the body. These floating chemicals irritate the tissue cells so they produce new soluble "defensive" chemical bodies of their own. These chemical bodies are known generally as "antibodies." An "antigen" is a chemical body that causes the production of "antibodies." (8) The chemical reactions between the products of bacterial activity and the products of cellular activity may result in new injurious chemical compounds.

During an infection by pathogenic bacteria we have, then, local mechanical injurious effects and local and general toxic (poisonous) chemical effects. And so we have, in these infections, aches and pains,
headache, delirium, paralysis, unconsciousness, nausea, vomiting, chills, fever, rapid breathing and rapid pulse. Some diseases leave us with blind eyes, deaf ears, crippled hearts, useless kidneys, stiff joints or a damaged mind. Death is by no means the worst injury pathogenic bacteria may cause in man.

**Final Results of Infection with Pathogenic Bacteria**

Some infections are notoriously fatal. (1) 800,000 persons died of cholera in Russia in 1892. (2) Over 77,000 persons died of tuberculosis in the area of registration in 1921. (3) Over 8,000 people died of typhoid fever in the area of registration in 1921. (4) Over 7,500,000 human beings died of bubonic plague in India between 1890 and 1915. (5) At one time over 40 per cent. of children infected by the diphtheria bacillus died. Now, with treatment by antitoxin, the rate is less than 9 per cent.

There are other serious bacterial diseases which might be listed here. On the average about 5,000 persons die of infectious disease every day in continental United States. The majority of these deaths are caused by bacterial infection.

A number of these infections leave the individual crippled in mind or body. Diphtheria may leave paralyzed nerves. Typhoid fever may leave bad kidneys or a weak heart; meningitis may leave blind eyes or deaf ears; gonorrhea often leaves sterility, blind eyes or crippled joints.

The majority of persons in good health recover from their first attacks of infectious disease. These recoveries are due to the fact that the tissue cells of the human body have the power of manufacturing specific defenses against various infections (antibodies, etc.).

**Elimination of Pathogenic Bacteria from the Human Body**

During an attack of bacterial disease and sometimes for long periods after, the specific bacteria that caused the disease are expelled from the body in enormous numbers, by way of the various avenues of excretion. In fact, the several excretions always contain pathogenic organisms even in health. The organisms that cause disease of the air passages are expelled largely by way of the nose and the mouth. Some of these organisms are swallowed and escape along with the intestinal excretions. The organisms that cause disease of the intestinal tract are expelled by way of the bowels. The organisms that cause disease of the genito-urinary tract are expelled by way of discharges from that tract.
The Carriers of Disease.—Any agent that brings these pathogenic bacteria to human beings becomes thereby a carrier of disease. The source of nearly all human infection is the human carrier. Pathogenic bacteria may be transferred from one human being to another by direct contact. The most typical examples of infection by direct contact are found in the sexual transfer of venereal diseases. Pathogens may be transferred a little less directly through “droplet infection,” that is, by way of the fine spray of mucous and saliva that accompanies coughing, sneezing, etc. The transfer may occur by way of infected food, water and articles in common use. Several insects which feed and breed in human excretions or feed on human blood are known to be carriers, e.g., the mosquito, the fly, the louse and flea. Some animals may serve as carriers, e.g., the cat, the dog, the rat.

XV

THE PROTOZOA THAT INJURE HEALTH

The protozoa are very small animals. Some of them are large enough to be seen by the naked eye, but most of them may be seen only with the help of a microscope. There is evidence that some of the disease organisms that are small enough to pass through the fine pores of porcelain bacteriological filters are protozoa.

The protozoa are simple one-celled animals. The bacteria are simple one-celled plants. All of the functions, all of the activities, all of the work of these animals are performed by the one simple cell of which each is made. In the higher animals, for example the human animal, the work of living is divided between the millions of specialized cells which, taken together, form the animal body. Thus, our muscle cells do our heavy work; our nerve cells do our feeling, seeing, smelling, tasting, directing and thinking. A nerve cell that assists in the complex function of seeing has no part in the function of smelling. Every cell is a specialist. But in the protozoa, the one microscopic cell does all the things that protozoa are able to do.

One of the most typical of the protozoa is the ameba. The ameba under the lower power microscope looks like a dirty gray drop of water. When it eats, it flows around the food particle that happens to be in its way. It does not seem to have any particular mouth part. This curious way of eating is called “phagocytosis.” It is characteristic of amebas. It is also characteristic of the white blood cells and certain other cells of the human body. When it excretes, the particles excreted seem to be thrown out anywhere through the surface of the ameba. It
travels very slowly by simply flowing along much as a drop of water might if it could push out a tiny projection in any direction and then flow into the little projection. This curious way of moving about is called “ameboid motion.” It, too, is characteristic of the white blood cells and certain other cells of the human body. We will have more to say about these white cells at another time.

The protozoa are not so uniformly alike as the bacteria are. They are all one-celled but they differ in many ways. For these reasons it is hard to describe the protozoa. About seven thousand species of protozoa have been described.

The protozoa live in sea water, fresh water, damp soil, vegetable matter and animal matter.

These organisms reproduce by simple division, by sexual conjugation, and by spore formation. They multiply quite as rapidly as bacteria do.

Some forms of protozoa pass through certain stages of growth in regular sequence, so that from time to time the appearance of the protozoa changes most remarkably. This typical and regular sequence of changes in the case of any given protozoan is called the “life cycle” of that protozoan.

The life cycle of the malarial parasite, for instance, is made up of a cycle of development which includes a period of development in the red blood corpuscle of the human and a period of development in the stomach and salivary pouches of the mosquito. Other protozoa have even more complex cycles than this. A knowledge of these cycles is of great importance in our warfare against the protozoa that cause disease.

The pathogenic protozoa require special surroundings. These surroundings must be of the right temperature, moisture and darkness and must contain the requisite food. So far as we know the protozoan of malaria will live nowhere else than in human blood and in the body of the mosquito; the trypanosome of sleeping sickness will live nowhere save in warm-blooded animals and certain biting, blood-sucking flies; the protozoan of smallpox only in humans and cows (monkeys also).

Protozoa are destroyed by drying; by high and low temperatures; by sunlight and by any radical change in their natural environment.

Relation of Protozoa to Human Health

Protozoa are grouped into pathogenic protozoa and non-pathogenic protozoa. It is possible but not probable that under special conditions the pathogenic forms may become non-pathogenic, and the non-pathogenic, pathogenic.
The Pathogenic Protozoa

The Malarial Parasite.—Malaria is caused by an animal parasite which is called the plasmodium of malaria. This plasmodium is so small that it can be sucked through the capillary bore of the proboscis of a mosquito—so small that hundreds of them may grow in the stomach of a mosquito; so small that hundreds of them may live in the salivary pouches of a mosquito waiting to be squirted into human tissues when the mosquito feeds on human beings. It is so small that it can enter the red blood corpuscle (there are 4,000,000 red blood corpuscles in a cubic millimeter of blood with plenty of room to spare) and multiply in the red corpuscle until there are a score or more of the young parasites produced in that single red cell. The parasite of human malaria grows only in the human being and in the anopheles mosquito. Without the mosquito or the human, the parasite could not live. Malaria is a common disease. Malaria is never caused by anything else than the plasmodium of malaria. Malaria is transmitted through the mosquito. Without the mosquito there would be no malaria. The only mosquito that carries this parasite is the anopheles mosquito.

The trypanosomes form another important group of protozoa, some members of which cause serious disease. The disease caused by these organisms is called trypanosomiasis. Infections from different trypanosomes occur in South America, Africa, Southern Europe, Persia, India, Burma, China and the Philippines. Many kinds of animals are affected as well as man. A typical trypanosome is a very small, elongated, flattish animal looking something like an eel. It has a flagellum or hair-like process on one end and a finlike membrane extending from the flagellum along the whole length of the body. Its movements are very active. These organisms live and multiply in the blood of animals and man. Life cycles have been described for them. The only disease of human beings caused by these organisms is sleeping sickness or human trypanosomiasis. It is caused by a specific trypanosome which is called the Trypanosoma Gambiense. The organism is carried from man to man or from animal to man by the tsetse fly, and perhaps other blood-sucking flies. Up to the present time they have been found alive only in the blood of human beings and some animals, and in the stomach and sucking apparatus of the tsetse fly. This disease is limited to the regions occupied by these flies, which limitation at the present time confines the disease to parts of Africa. Here the disease is a terrible scourge and produces a most serious and fatal sickness.
The ameba is another protozoan, some forms of which cause disease. Amoebic dysentery has been found more or less all over the world, particularly in tropical and sub-tropical countries. The ameba is a microscopic organism of very considerable biological interest. I have described it to you rather inadequately in the earlier part of this lecture. I advise you to consult a book on biology or zoology for further information. The chief carrier of this organism is drinking water which has been contaminated by the excretions of persons or animals sick with the disease. The disease itself is very uncomfortable and painful. Many patients die. The endameba buccalis is thought to be the cause of pyorrhea dentalis, a very common and a very important disease of the gums.

The spirocheta pallida, or the treponema pallidum, is probably a protozoan. This spirocheta is very small, but is larger than the average bacterium. It is long and slender, shaped like a thread, though somewhat broader. It has a curious spiral movement. The spirocheta pallida or treponema pallidum is found in the blood, tissue juices, secretions and sores of syphilitic victims. It is the cause of syphilis, discovered in 1905 by Schaudin and Hoffman. This organism is transmitted by intimate contact as in sexual intercourse, drinking from contaminated cups, eating with contaminated spoons, smoking the pipe of a syphilitic individual, etc. Syphilis is always derived from some one who has the disease. It may come through some innocent medium—a cup, a pipe, a drink, a kiss. It has destroyed more children, crippled more men and women, ruined more homes than you can imagine. It is one of the most common and most serious diseases of civil life and in military life it sometimes does more damage than the weapons of war. It is most frequently secured through illicit sexual intercourse but may be spread by contact from husband to innocent child; from guilty brother to innocent sister, mother or friend. There were over 23,000 cases of syphilis reported for the State and over 13,000 for the City of New York in 1922.

THE PATHOGENIC METAZOA, OR THE MULTICELLULAR ANIMAL PARASITES THAT CAUSE DISEASE

This group of agents that cause disease includes a number of higher animal parasites, their eggs, embryos and larvae. The more important members of the group are the flukes, tapeworms and their larvae (bladder worms), hookworms and other round worms.
The Frequency of Parasites.—There is no species of animal and no race or class of men known to be free from parasites. (Stiles.)

Influence of Parasites Upon Their Hosts.—The injury done may vary with species, size, location and the number of parasites and with the condition and age of the host. This injury may be accomplished in various ways: Nourishment is taken which should go to the host; blood is taken by the parasite for food; mechanical pressure irritates or causes atrophy of organs or parts of organs; natural channels may be obstructed; the wandering of the parasite may cause irritation; substances may be excreted which have a toxic influence and which may change the condition of the body fluids; injury to the intestinal mucosa or to the skin may form points of entrance for bacterial and protozoan infections.

Trichinae

Description.—The adult worm lives in the upper part of the intestine. The male is 1.4 to 1.6 mm. long and 40 u. in diameter. The female is 3 to 4 mm. long and 60 u. thick.

The female lives in the lumen of the intestine or bores into its walls and deposits her young during a period of five or seven weeks. Each female produces about 1,500 embryos in that length of time. These embryos are considerably smaller than the adult organism. They wander with the lymph or blood to the striated muscles. Here they locate and develop into "encysted larvae" or, as they are commonly called, "flesh worms."

These encysted larvae remain alive and lie curled up in the muscle for years. This larva stage is the infective stage. When meat containing these larvae is eaten, the cysts are destroyed in the stomach and the larvae pass into the small intestine and develop there into adult forms.

Carriers of Trichinae.—Humans, hogs, wild boars, rats, dogs and cats are affected by the disease and contain the encysted larvae in their tissues. The hogs may carry the disease to human beings. The hogs, rats, dogs and cats carry the disease to each other.

The Disease of Trichinosis is always uncomfortable, frequently serious, and occasionally fatal. It is not a common disease. A small outbreak of trichinosis occurred in the Borough of Queens in February, 1916. Twelve persons were treated at St. Joseph's Hospital. In spite of the best of care four of the patients died.
Tapeworms

Man becomes afflicted with tapeworms by eating flesh containing the encysted larvae of the parasite or by eating food that has been contaminated by the excretions of dogs, cats, rats, mice, or by transferring the eggs directly to his mouth on his fingers.

Some tapeworms grow as long as thirty feet. Others are only a few millimeters in length. They grow in segments and are flattened. The head end contains suckers and in some forms is armed with hooks.

Tapeworm disease is caused by eating the larvae of tapeworms in insufficiently cooked beef, pork and fish. Tapeworms of less common occurrence may be secured from dogs and rats by handling them and transferring the eggs on the fingers to the mouth or by eating food they have contaminated. One tapeworm is liable to lay 150,000,000 eggs a year, so that the chance of spreading the disease is not to be underestimated. People who carry tapeworms are usually starved. They lose weight, become thin, emaciated, and, if unrelieved, may die. Cook your meats thoroughly; never eat them raw.

Hookworm

The Hookworm is an animal parasite of about the size and shape of a slightly bent pin. There are two well-known hookworms—the old world hookworm and the new world hookworm. They are very much alike. The young hookworm develops from eggs that have been cast out in the fecal discharges of human beings sick with hookworms. These eggs hatch if they chance to be left in warm, moist surroundings. After a few weeks the young hookworm is ready to attach itself to its human victim. If the young worm happens to have developed in dejections that were cast in or near a vegetable garden it may be carried to the table in green food such as celery, radishes, lettuce and the like. If a bare-footed human walks through the grass in which there are young hookworms, the little worms may get on his feet, bore through the skin and thus find their way by a devious route to the intestinal canal. The adult life of the hookworm that is picked up by the human is spent in the intestinal canal of that human. Here the worm fastens itself by means of its sharp teeth into the intestinal wall. It sucks the blood of its provident host and poisons him with its toxic excretions.

The great majority of our Southern farms have no privies. The great majority of our Southern country folks go barefooted. The great majority of our Southern country people are not careful in their habits of hygiene. And so the great majority of our Southern rural
population have hookworms. The hookworm belt reaches from 30 degrees south latitude to 36 degrees north latitude and goes around the world. It holds over 400,000,000 persons affected with hookworm. Those people are injured physically, mentally and morally. They are educationally and economically depressed or paralyzed.

Whenever people suffering with hookworm are persuaded to undergo treatment and to practice habits of good hygiene, their disease disappears, and they often become wide-awake, useful citizens. The Rockefeller Foundation has proven the value of hygiene most dramatically in the hookworm sections of our Southern States.

XVII
THE UNKNOWN CAUSES OF DISEASE

Causes of Cancer

Cancer is a disease of middle life and later life. It is one of the most hopeless of all the diseases of mankind. Practically every advanced case has resulted in the death of the patient.

The cause of cancer is not known.

Chronic irritations often pass into cancer. Chronic ulcerations, irritated scars, moles, warts, benign tumors, and other irritations of long standing are called precancerous conditions because they frequently develop into cancer. We do not know why they develop into cancer.

Cancer may be produced in some of the lower animals by inoculating them with cancerous tissue from other animals.

Cancer has been produced in rats that have been fed with cockroaches in which certain intestinal parasites were present.

Cancer in mice is more likely to reappear in mouse families in which it has already appeared. We have no proof that human cancer is inherited.

Fish and dogs have developed cancer when fed on scrapings from aquaria in which fish with cancer had been living.

Sarcoma has been produced in chickens by inoculating them with a filtered emulsion of sarcomatous material taken from other chickens. These and other animals will undoubtedly enable us finally to discover the cause and the cure for cancer and other like malignant growths.

Precancerous conditions are dangerous. Take good care of all ulcers, wounds, scars, moles, warts and other irritations. Cancer is on the increase. More than 95,000 persons died of cancer in the United States in 1922.
We do not know the causes of the following diseases: Smallpox, chicken-pox, scarlet fever, measles, mumps, yellow fever, rabies, Rocky Mountain fever, trachoma and break-bone fever. There are other diseases in this group.

Our ignorance concerning the causes of these diseases may be due to: (a) Lack of technique. Our knowledge of micro-organisms depends upon our ability to bring them into view; cultivate them and experiment with them. We must isolate a disease cause before we can make a study of it. (b) Many of these causes are too small to be seen with power of magnification now at our disposal. A study of filterable viruses began in 1898. We know that the causes of the following human and animal diseases are so small that they will pass through bacteriological filters. We call such organisms filterable viruses, ultramicroscopic viruses or filtrate viruses.

**XVIII**

**THE FILTRATE VIRUSES**

Diseases of domestic animals: Pleuro-pneumonia of cattle; African horse sickness, sheep-pox, cattle plague, hog cholera, swamp fever of horses, infections agalactia (sheep and goat), catarrhal fever of sheep, distemper of dogs, infectious stomatitis papulosa of cattle, guinea pig epizototic, a peculiar paralysis of guinea pigs, and a rat disease.

Diseases common to man and animals: Foot and mouth disease, rabies vaccinia and smallpox.

Diseases of man: Yellow fever, molluscum contagiosum, dengue, fever, verruca vulgaris, trachoma, sand-fly or three-day fever, poliomyelitis, typhus fever, trench fever, measles and scarlet fever.

Diseases of birds: Fowl pest, fowl diphtheria, chicken sarcoma.

We know very little about these minute causes of disease, but our knowledge is on the increase. At present we know: (1) That some of these diseases are carried by biting insects such as the mosquito, the fly, the louse and the tick. (2) That others are introduced through grosser injuries as in rabies. (3) That some of these diseases are transmitted by contact. (4) All of these disease causes are destroyed by high temperature, some of them more easily than the bacteria. (5) Some of them are more resistant to drying than bacteria are. (6) They resist cold. (7) A few have been cultivated in the laboratory. (8) The extreme minuteness of some of these disease causes, combined with their resistance to drying, may account for their contagiousness.
“Minute particles suspended in air or in liquid obey the laws which govern the diffusion of gases and substances in solution in liquids.” (Wollbach.)

XIX

LAST HEALTH TALK

Summarize the objects of the term’s work in Hygiene (see Chapter I).

(a) Aim and usefulness of student health examinations. Present statistics as to teeth, vision, etc., of this class. Point out that “habits” of health examination and physical repair may be formed and urge their continuation.

(b) Health protection through the avoidance of the causes and carriers of disease. The “floor talks” this term have indicated ways and means of securing health protection.

(c) Wise habits of daily life have been emphasized in these floor talks (nourishment, excretion, work, exercise and recreation, and rest).

(d) What have you done for the man you are to be? Have you wasted his opportunity? Have you neglected his training? Will he be bigger, stronger, and more vigorous because of your care this term? Will he be sick less, will he be more useful, will he live longer and will he be happier? You are master of the man you are to be—will he thank you or blame you?