THE NURSES
TEXT BOOK SERIES

HYGIENE

AND

SANITATION

A TEXT-BOOK FOR NURSES

BY

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TO

LILLIAN D. WALD

THE PIONEER OF PUBLIC HEALTH NURSING IN

THE UNITED STATES AND THE FOREMOST ADVOCATE

FOR THE EXTENSION OF THE SCOPE OF

THE NURSE'S WORK

THIS BOOK

IS DEDICATED IN APPRECIATION AND RESPECT.

PREFACE.

The last decade has seen a wonderful expansion of the function of the trained nurse and a great broadening of the scope of her usefulness. No longer are her duties limited to the simple care of the sick. The nurse has become a priestess of prophylaxis. Her work in preventive medicine has become invaluable. She has become an important factor in social, in municipal, and in public health work.

No one at present denies the great utility of the nurse's work in the school, in the factory, in the social part of dispensary work, in the milk stations, in the preventive work undertaken by life insurance companies, and in many other public health activities which have been opened to her. In all these activities a fundamental knowledge of the principles of hygiene and public health is necessary for intelligent work and usefulness.

This book is an attempt to give the nurse a knowledge of the elements of hygiene in its various branches. Disputed points and too detailed instructions on minor points have been avoided. Rules for the care and treatment of diseased persons have been omitted, as these are taught to the nurses in their regular curriculum in the training school.

It is gratifying to note that the hope expressed in the preface of the first edition, that the book might be useful to the nurse in the discharge of her manifold duties, has been fulfilled, as is evidenced by the need for a third edition within the first four years of publication.

The text of the book has been considerably changed. A new chapter on Infectious Diseases has been added, the chapter on Personal Hygiene has been considerably amplified, the chapter on School Hygiene has been elaborated, and the text of the other parts of the book has been carefully revised and brought up to date.

G. M. P.

New York, 1917.

CONTENTS.

CHAPTER I.

Introduction to the Study of Hygiene.

Definitions—Foundations of Modern Hygiene—Conservation of Human Resources—Further Possible Prevention of Disease—The Role of the Nurse in Prophylaxis . . 17

CHAPTER II.

The Hygiene of Habitations.

Influence of Housing on Health—Safety and Fire Protection—Light and Illumination—Air—Ventilation—Heating — Water Supply — House Drainage — Plumbing — Plumbing Pipes and Fixtures—Water Closets—House Waste Matters—House Cleaning 24

CHAPTER III.

The Hygiene of Foods and Food Supply.

Dietetics and Preparation of Foods—Care, Storage and Preservation of Foods—Adulteration—Meat and Meat Supply—Milk and Dairy Products—Cow's Milk—Milk Products—Milk Adulteration—Milk Preservation—Milk Inspection and Testing 89

CHAPTER IV.

The Hygiene of Schools and of School Children.

The School Child—The School Building—The Care of the Child in School—Functions and Duties of School Nurses 148

CHAPTER V.

The Hygiene of Occupations.

Occupation and Health—Industrial Factors Influencing Health—Specific Occupational Dangers—Industrial Betterment—Functions and Duties of the Factory Nurse . 166

CHAPTER VI.

Infectious Diseases and Their Prevention.

I. General Considerations: The Infectious Diseases—Classification—Stages—Morbific Agents—Portals of Entry—Modes, Vehicles and Agents of Transmission.

II. Principles and Practice of Prevention: Mortality—Progress in Prevention—Methods of Prophylaxis—Individual Immunity, etc. — Disinfection — Social Measures of Prophylaxis.

III. The Role and Functions of the Nurse in Prevention of Infectious Diseases: Public Health Nursing—District Nurses—Nursing in Tuberculosis—Measles—Scarlet Fever — Diphtheria—Pneumonia—Typhoid —Poliomyelitis—Erysipelas 190

CHAPTER VII.

Personal Hygiene.

Activity and Rest—Food and Dietetics—The Caloric Value of Food—Elimination—Personal Hygiene of the Child—Personal Hygiene of the Aged—Personal Hygiene of the Sick 241

HYGIENE.

CHAPTER I.

INTRODUCTION TO THE STUDY OF HYGIENE.

HYGIENE is the oldest and the youngest of all sciences.

Hygiene is the oldest of all sciences because the preservation of life and health is an instinct born in the animal, and the common endeavor of human beings to preserve their health and to prolong their lives is as old as human society and dates from the beginning of mankind.

Hygiene is the youngest of all sciences because it could only become a science when physiology, bacteriology, and vital statics had been firmly established upon a scientific basis.

Definitions.—Hygiene is the science and the art, the theory and the practice of the preservation and the promotion of human health and life.

The aim and function of hygiene are the prevention of disease, the prevention of premature death, and the promotion of normal health in human beings.

Hygiene may be personal or public, municipal, State, and Federal. We also distinguish particular

2

branches of hygiene, such as the hygiene of housing, of food, of school, of industry, etc.

Personal hygiene is the science and the art of the preservation and the promotion of *individual* health and life by the prevention of constitutional diseases and by the increase of the vital force and resistance of the human body.

Public hygiene is the science and the art of the preservation and the promotion of public health by the prevention of environmental causes of disease, and by the improvement of conditions common to many persons and communities.

Sanitary science is the theoretical part of hygiene. It is based upon the investigations of the influence of environmental conditions, upon the health and life of human beings, and has for its aim the study of these conditions and of their effect upon the health and life of man.

Sanitation is the sum total of practical measures undertaken for the preservation of public health.

Sanitary art is the practice of public hygiene, the erection of public works for the improvement of public health.

Sanitary law or public health law or State medicine are terms applied to the rules, regulations, and laws prescribed by States or municipalities for the conduct of individuals and communities, with the aim to preserve and promote public health.

Foundations of Modern Hygiene.—Modern hygiene is based principally upon three sciences: sanitary science, bacteriology, and vital statistics.

Sanitary Science.—Men have known their dependence upon the soil upon which they dwell, the air which they breathe, the water which they drink, the food which they eat, the houses in which they live, and the many other external factors by which their life and well-being are so profoundly influenced. It is scarcely more than three score years, however, since sanitary science, the science of the environmental factors, has been firmly established and the direct causative influence of the various external factors has been fully shown. Chadwick, Farr, Pettenkoffer and others were the first to study the effects of soils, waters, foods, clothing, and the general environment of man. Only when the influence of these factors had been demonstrated could hygiene enter the rank of modern sciences.

Bacteriology.—The greatest impetus toward the establishment of modern hygiene has been given by bacteriology. Pasteur, Koch and a host of other investigators during the nineteenth century have discovered the hitherto hidden causes of many diseases which were destroying innumerable human beings. These discoveries of the germs causing disease have made possible the prevention of disease and the prolongation of the human life by the study and discovery of proper means of fighting the destructive agents of disease.

Vital Statistics.—Hygiene is based on vital statistics. Vital statistics may be termed "public health bookkeeping." As in economic and financial undertakings it is impossible to determine the exact state of affairs and progress without a system of bookkeeping, so it would be impossible without such a system to determine the state of public health, its decline and fall, or rise and progress. By the means of vital statistics the number of persons of various ages, sex, nationality, etc., living in a given period in a given place may be determined, and the actual and natural increment of population, the birth-rate, marriage-rate, death-rate, etc., in a given year, period, or locality may be learned.

Vital statistics also show the general morbidity-rates, the rates of specific diseases, the probable *duration* and the *expectation* of life.

Since vital statistics have become an established science among civilized nations, the waste of human life from the various causes and the progress of sanitary endeavor by the efforts of personal, municipal, and public hygiene have become evident.

Conservation of Human Resources.—The function of hygiene is the conservation of human resources and the prevention of the waste of human life, of which there is still a lamentable and deplorable waste from preventable causes.

Upon examining the recorded causes of death in any given community, it is found that only a very small percentage of deaths (less than 2 per cent.) is due to old age. The other 98 per cent. of all deaths are caused by disease and pestilence, by violence and war, by sin and crime.

Hundreds of thousands of innocent infants and children are still killed, crippled, and maimed by infectious diseases. The lives of thousands of adults are still being destroyed by typhoid, tuberculosis, and many other diseases of adult life. Pneumonia, nephritis, and other constitutional diseases are still the causes of innumerable deaths. Many, if not all, of these are largely preventable. Great as is the waste of human life at present, it is incomparably less than in the past. Great sanitary progress has been made during the last and present centuries. The average length of life has been considerably lengthened, the mortality-rates have decreased, and many diseases which were among the worst enemies of mankind have either entirely disappeared or their ravages have been materially lessened.

The length of life has increased over 100 per cent. during the last few centuries, the progress having been greatest during the nineteenth century. During the sixteenth century the average length of life was from eighteen to twenty years, during the eighteenth century it was a little over thirty years, while at the end of the nineteenth century it reached thirty-eight to forty years. The general mortality-rate in London per 1000 inhabitants in the year 1680 was 50; in 1780, 40; in 1905, 15.1. In Berlin the rate from 1751 to 1780 was 39.34 per 1000 inhabitants; from 1841 to 1870, 28.78; from 1871 to 1900, 26.22. In urban America (white) this rate from 1804 to 1825 was 24.6; from 1826 to 1850, 25.7; from 1864 to 1875, 25.4; from 1876 to 1888, 22.9; and from 1889 to 1901, 21. In New York the rate was 25.99 in 1886, 16.52 in 1908, and less than 12 in 1916.

There has been a great reduction in the mortality from certain diseases like smallpox, yellow fever, diphtheria, cholera, typhoid fever, and malaria. During the eighteenth century 50,000,000 people died of smallpox in Europe; in 1900 there were but 3500 deaths from it in the United States.

Since 1793 the United States has had 500,000 cases of yellow fever, resulting, it is estimated, in about 100,000 deaths. Since the discovery of the species of mosquito which transmits the causative factor, and the practical preventive measures to which this has led, the cases of yellow fever have been greatly reduced. In Havana there were 4420 deaths from this cause in the eight years from 1891 to 1898, while in the eight years from 1899 to 1906 they numbered but 465.[1]

The reduction of the mortality-rate from typhoid fever has also been great but not yet as marked as that of yellow fever, cholera, and smallpox.

The Main Causes of Disease.—A preliminary announcement with reference to mortality in 1915, issued by the Bureau of Census, indicates that nearly one-third of the 909,155 deaths reported for that year in the "Registration Area" which contained approximately 67 per cent. of the population were due to three causes—heart diseases, tuberculosis and pneumonia; and nearly two-thirds were due to twelve causes—viz., cardiac diseases, tuberculosis, pneumonia, nephritis, cancer, apoplexy, intestinal diseases, arterial diseases, diabetes, influenza, diphtheria and typhoid fever.

Further Possible Prevention of Disease.—Though much has already been accomplished in the prevention of disease and in conservation of human life, a great deal more may be done by proper sanitary measures and hygienic control.

According to the calculations of Professor Fisher, "the length of life could easily be increased from forty-five to sixty years, a prolongation of fifteen years. This would result in a permanent reduction in the

[1] Report on National Vitality.

death-rate of about 25 per cent. The principal reductions would come from the prevention of infantile diarrhea and enteritis (over 60 per cent.), bronchopneumonia (50 per cent.), meningitis (70 per cent.), typhoid fever (85 per cent.), tuberculosis (75 per cent.), deaths by violence (35 per cent.), pneumonia (45 per cent.), so that the estimate of fifteen years' prolongation of life is a safe minimum without taking into account possible future discoveries in medicine or the cumulative influence of hygiene."

The Role of the Nurse in Prophylaxis.—Among those combating disease and death there are few whose work is so far-reaching and whose endeavors are so valuable, or whose work is as important in prophylaxis as that of the nurse. Since Florence Nightingale had demonstrated the need and value of the nurse in war, an even more emphatic demonstration has been made of the nurse's value in peace. Not only as an aid to the physician, but also by her own work in prophylaxis, has she become one of the most important conservators of human life, and her role in the prevention of disease and premature death cannot be overestimated.

Within a comparatively short time the number of nurses in the United States has been increased to many thousands. At present the nurse is found not only at the sick-bed in the individual home, but also in the tuberculosis clinics, in factories and workshops, in department stores, in tenement-house departments, health departments, and in a great many private as well as public institutions. There is no doubt that her field of work and usefulness will be still further expanded until it will embrace all human activities.

CHAPTER II.

THE HYGIENE OF HABITATIONS.

Among the factors of external environment there are few which play so important a role in the life of man as his habitation. Housing conditions are powerful factors in the preservation of human life and the prevention of disease.

There is an intimate relation between the disease and death-rates of populations and the conditions of their housing. The density of population in areas and localities, congestion and overcrowding in houses and many other factors directly influence the health of the population.

The house plays also an important role in the safety of its inhabitants, while the proper fire protection of the house is a direct factor in the elimination of dangers of fires to life and limb.

The diseases which are associated with housing conditions are those due to transmission by the bites of insects and parasites, those due to the emanations of gases and also those due to bacterial origin. Bronchitis, influenza, tuberculosis and pneumonia are diseases closely associated with housing conditions. Several diseases due to intestinal bacteria, such as typhoid fever, dysentery, cholera and hookworm disease are often associated with defective conditions in houses which favor the transmission of infective bacteria and dissemination of disease.

Improvements in housing conditions, the decrease of density and congestion, prevention of overcrowding, improved fire protection, better lighting and ventilation of houses, improved sanitary conveniences and comforts, have always led to better health conditions of the population.

The important factors in housing conditions which will be briefly discussed are the following: Safety and fire protection, light and illumination, air and ventilation, heating, water supply, disposal of sewage, plumbing and disposal of house wastes.

SAFETY AND FIRE PROTECTION.

The safety of house and inhabitants depends upon the proper construction of the house. Houses must be constructed of proper materials in a workmanship manner in order to prevent accidents due to insecure walls, falling plaster from ceilings, tripping over bad stairways and other accidents so frequent in badly constructed houses.

Loss of life or dangers to life and limb from fires in houses may be prevented by building houses of fire-resisting and fireproof materials and by the provision of ample exits to enable the inhabitants to escape from the house during fires or panic. The necessity for constructing houses of many stories in densely populated cities has led to the increase of dangers from fires in multiple dwellings and tenement houses. Progressive housing legislation demands the construction of houses of fireproof materials, the enclosing of all shafts, such as elevators, dumbwaiters, etc., by fireproof partitions provided with self-closing fireproof doors. In practically all modern cities the construction of frame dwellings has been prohibited in the city area.

Exit in case of fire is provided for by means of wide, properly lighted, fireproof stairways and also by the construction of special fire escapes outside of the building, which serve as an exit in case of emergency.

Fire escapes are constructed of iron and consist of balconies in front of one or more windows in each apartment, these balconies on each floor being connected with iron stairways facilitating the descent of the inhabitants of each floor to the ground or their ascent to the roof by means of goose-neck ladders.

LIGHT AND ILLUMINATION.

Natural Light.—Sunlight is essential to the growth of animal and vegetable life; it acts beneficially upon health, stimulates the metabolism of the body and assists in the oxygenation of the blood. Sunlight is also a powerful germicide and disinfectant; it kills low organisms, fungi, and moulds, is capable of destroying tubercle bacilli within a short time, and is therefore indispensible in human habitations. Habitations without direct sunlight are damp, cold, and unhealthy.

The amount of natural light within a house depends on:

1. The location and aspect of the house.
2. The sources of light.

3. The location and size of the openings through which is penetrates.

4. The character of windows and of surface within the house.

Direct rays of the sun give more light than reflected lights from adjacent surfaces, walls, trees, etc. Greater light is obtained through horizontal openings on top of the house than from windows in vertical walls.

The intensity of light within a house depends also upon the character of the window glass. There is a loss of light of 50 per cent. through milk glass, 10 per cent. through double glass, and 8 per cent. through plate glass. Prism or ribbed glass, by distributing and reflecting the rays of the light evenly through the room, increases the amount of light.

The window area of a room should not be less than 10 per cent. of the floor area; one square foot of glass surface should be allowed for every 70 cubic feet of interior space. Piers between windows should be narrow; window tops should extend to the ceiling, or at least to within 6 inches of it. Plate glass is best for transmission of light, unless prism glass is used. Smooth, light, or light colored surfaces of inner walls and floor and ceilings increase the amount of reflected light.

Artificial Light.—Artificial illumination in the house is obtained from tallow and paraffin candles, oil or alcohol lamps, water-cooled or acetylene gas, and from electricity. The value of artificial illumination depends upon its source, quality, intensity, heat production, impurities generated, safety and cost.

The best light is that obtained from electric current through tungsten lamps.

Acetylene gas may produce a very intense and brilliant light of from 20 to 160 candle power. The intensity of other lights depends on their material, the character of the burners, etc. Welsbach lights are made of mantles impregnated with earthy silicates, which become incandescent upon slight heating. They give from 60 to 120 candle power.

All illuminants, except electricity, produce much heat and give off some impurities, such as carbon monoxide, carbon dioxide, sulphur compounds, ammonia compounds, smoke, soot, and moisture.

Acetylene Gas.—Acetylene gas (C_2H_2) is produced by mixing water with calcium carbide, and during this process much heat is evolved. Special generators are manufactured for the production of the gas, and, contrary to the current opinion, there is little danger from explosions, as calcium carbide is not explosive either by heat or by concussion. The pipes used for ordinary gas illumination may also be used for acetylene lights, but the openings of the tips of the burners must be smaller. The light is intense, steady, white, and cheap, and is well adapted for houses in rural communities or wherever there are no central plants for the manufacture of electricity or coal gas.

Coal Gas.—Coal gas is made by heating bituminous coal in air-tight vessels. During this process the compounds of hydrogen and carbon are transformed into other gaseous and solid products. The refined gas contains about 50 per cent. of hydrogen, 35 per cent. of marsh gas, 6 per cent. of carbon monoxide, and 9 per cent. residue.

Water Gas.—Water gas is manufactured from anthracite coal, steam, and petroleum by a complicated process. The refined product contains 30 per cent. of carbon monoxide; 35 per cent. of hydrogen, 20 per cent. marsh gas, and 15 per cent. residue.

Because of the greater amount of carbon monoxide, water gas is more dangerous to life and health than coal gas. The inhalation of even small amounts of water gas is injurious. Large amounts may become fatal because the carbon monoxide combines with the hemoglobin of the blood and forms an insoluble compound.

Coal gas and water gas are manufactured in central plants, from which they are conducted through iron tubes and pipes under the streets into houses, and through a network of smaller iron pipes throughout the houses. The gas-service pipes are made of best wrought iron with malleable iron fittings. The house service should be provided with main and secondary stop-cocks, and meters to measure the amount of gas consumed.

The gas-service system must be perfectly air-tight, should be exposed and readily accessible, and should be tested for air-tightness by appropriate tests before use.

Gas fixtures are of various shapes and values. The intensity of illumination greatly depends on the character of the burner. Argand and Welsbach burners are the best.

Too intense or too brilliant light, causing glare, may be the direct cause of serious affections of the eye. For the prevention of glare, lamps should be provided with proper shades, globes, etc.

AIR.

Air is a compound gas, a mixture of several gases. Its chemical composition is as follows: Nitrogen, 78.09; oxygen, 20.94; argon, 0.94; carbon dioxide, 0.03; with traces of other gases, helium, kryton, neon, xenon, and hydrogen.

The quantity of nitrogen is constant, while the quantities of oxygen and carbon dioxide vary according to different conditions. In the outside air the variation of carbon dioxide is between 0.03 in the very purest mountain air to 0.04 in the air of city streets. The amount of oxygen does not vary much in the outside atmosphere.

Air, like all gases, diffuses itself through space, and its weight is due not only to its chemical constitutents, but also to its physical condition, especially to its temperature and humidity. The lower the temperature of the air, the heavier it is. Warm air is lighter than cold air. As the temperature of the air at some places is much lower than at other places this difference causes variations in weight and produces a general motion of air through space, a motion which is often perceptible, and when rapid, is known as wind.

Air also contains a certain amount of water in the form of moisture. The amount of moisture depends upon the temperature of the air. The higher the temperature the greater is the amount of moisture that the air can absorb. When air is saturated with moisture, that is, when it contains all the water it can absorb, the excess of moisture is deposited in the form of dew; it has reached then what is known as the "dew point." The utmost amount of moisture which air may contain without reaching the dew point is called *absolute humidity.* The difference in the amount of moisture which air at a given temperature may actually contain, and that which it must contain in order to reach absolute saturation, is called *relative humidity.*

Impurities in Air.—Air may contain certain impurities. These may consist of dust of mineral, metal, vegetable, or animal origin, or of various gases, the most common of which are carbon dioxide (CO_2), carbon monoxide (CO), etc. There are many sources of these impurities, such as artificial illumination, artificial heating, dust matter from outside or from the inside of the house, dust and débris from the various processes and work carried on within the house. Perhaps the most important source is the presence of domestic animals.

The changes which are produced by the presence of human beings are the following: (1) A diminution in the percentage of oxygen, (2) an increase in the percentage of carbon dioxide, (3) an increase of volatile odoriferous organic products, (4) a possible increase in the number of bacteria and microörganisms in the air, (5) an increase in the temperature, and (6) an increase in the relative humidity of the air in the room.

Combustion and illumination within the room or shop produce changes in the air according to the character and source of the combustion, the most important changes being the increase in temperature and humidity and the addition of certain gases, such as CO_2, CO, and others due to the processes of combustion and illumination. The physical and chemical processes going on within the shop add a large amount of dust from the processes amd materials used, and sometimes gases and fumes, due to certain chemical processes, are produced.

All these additions to and changes in the normal consistency of the air are usually regarded as air impurities and have a greater or lesser effect upon the human beings within the confined air spaces.

The Influences of Impurities in the Air upon the Health.—Some of the impurities within the house may have no deleterious effect. Others, in the form of dust, etc., may become injurious when their quantity is too large or when they are of a poisonous nature. Certain germs and bacteria may be found in the dust, and other impurities in the air may also become dangerous to health. Of the gaseous impurities, carbon monoxide (CO), from leakage of illuminating gas or from processes of combustion, is very dangerous, as even a small quantity of this gas is poisonous to human beings.

In another place[1] I have summarized the present opinion on the character and effects of confined air as follows:

1. That confined air in living-rooms and in workshops differs from normal air in the following respects:

   (*a*) Decrease in percentage of oxygen.

   (*b*) Increase in percentage of carbonic acid (CO_2).

   (*c*) Persence of certain volatile odoriferous organic products.

   (*d*) Presence of microörganisms and possible presence of infectious bacteria.

[1] The Modern Factory—Safety, Sanitation, and Welfare. By George M. Price, M.D., p. 162.

(e) Frequent addition of dust, gases, and fumes.

(f) Higher rate of temperature.

(g) Increase in amount of moisture.

2. That ordinary decrease of oxygen as found in inhabited rooms and shops probably does not exert any deleterious influence on the persons within them.

3. That an increase in the contents of carbonic acid (CO_2) from 4 parts to 15 and up to 100 parts in 10,000 volumes is not dangerous to health.

4. That it has not as yet been proved that the presence of organic matter in confined air has an important bearing upon the health of the persons therein, although a prolonged breathing of a large quantity of volatile malodorous products may be followed by nausea, loss of appetite, and general malaise.

5. That the presence of dust, gases, and fumes is extremely dangerous in proportion to their kind, character, and quantity and the condition of bodily resistance of the workers.

6. That while it is possible that tuberculosis and some other bacterial diseases may be due to aërial infection, the probability of such infection is not great.

7. That the ill effects commonly ascribed to impure, confined air of ill-ventilated rooms and shops are due not so much to the chemical impurities in the air, but to the physical properties, such as increased temperature, higher rate of humidity, and stagnation of the air surrounding the body.

8. That an increase of the temperature of confined air in workshops above 70° F., and particularly an increase in the wet-bulb reading of the thermometer above the same degree, is probably injurious to health

if maintained for too long periods, and may cause fatigue, lassitude, decreased metabolism, anemia, and loss of resistence, predisposing the workers to acute and chronic diseases.

VENTILATION.

By excluding the outside air by means of walls, ceilings, and floors, artificial conditions are created. Houses are habitable only as long as some provision is made for the exchange of air from the outside to the inside, and *vice versa*. The room air which becomes impure must be replaced by a supply of fresh air from without. This interchange of air is called ventilation.

The *quantity* of air which each individual needs depends on a great many conditions besides the air space within the house and the rate of influx. The older hygienists based their calculations on the carbon dioxide content and determined the amount at 3000 cubic feet of air per hour. They regarded the carbon dioxide contents of the room air as an index to the general purity, and held that whenever it exceeded 0.06, the room air was bad. The degrees of temperature and relative humidity are at present regarded as a more important index of the condition of the air in a room.

Natural Ventilation.—The main factor in ventilation is not so much the amount of space in the house as the amount of air which enters by various means. Air is a gas, and as such rapidly diffuses through the house. As most of the materials of which houses are constructed are porous, a certain amount of air enters and leaves through the walls, floors, and ceilings. A certain amount also passes through the cracks, crevices, and other slight openings which are found in even the best-constructed houses, near the windows, doors, etc.

The motion of air due to differences of temperature and, consequently, of weight is also an important factor in ventilation. The colder outside air tends to flow into the house while the warmer, lighter air in the rooms tends to flow out of the house. The greater the difference in temperature the greater the exchange of the air. There is therefore some ventilation in every house: (1) through the porosity of the building materials and the diffusion of the air through these materials, and (2) through various openings due to faulty construction, etc.

Chimneys also contribute largely to the interchange of air and form flues through which the warm air passes. When the wind blows over the openings of the chimneys it creates a suction or aspiration and large quantities of air are drawn out. The occasional opening of doors and windows also serves to allow the influx of outside air and the flowing out of the room air. The value of windows for ventilation depends, of course, upon their use. In ordinary houses, not inhabited by too many persons, these means of ventilation may be sufficient for all practical purposes. These various methods are grouped under the term natural ventilation.

There are also other means by which a larger and more frequent exchange of air is produced. These are openings made in the windows, in the walls, in the floor, or in the ceiling and the roof. They are termed air inlets or outlets, according to their position. Those at the lower part of a room usually serve as inlets for the cold air, while those at the upper parts usually serve as outlets for the warm air.

Sometimes the upper sash of a window is movable and tilted so as to allow the air to come in and out, or the glass panes are sliding or in the form of movable louvers, or the whole glass pane swings on a pivot. Circular openings sometimes are made in the glass pane and are either left open or fitted with a perforated sheet-metal circle revolving with the inflow and outflow of the air. The lower sash may also be raised and have a board placed beneath, thus allowing the air to get in upward through an opening between the upper and lower sashes. The walls may also assist in ventilation by special devices consisting either of perforated bricks, or boxes made to fit in the wall, with openings allowing the inflow of air. Such openings may also be made in the ceilings and roofs. There are innumerable devices, all serving as means of ventilation in ordinary houses.

Mechanical Ventilation.—This means removal of the air from the room or introduction of air into the room by mechanical means. The first is called the vacuum method, the latter the plenum method of ventilation.

The best method is that carried on from a central location and is a combination of the plenum or propulsion method with the vacuum or exhaust method. The air from the room is exhausted by mechanical means and is removed through a system of openings and tubes, and at the same time fresh air from without is mechanically introduced through tubes and openings.

The advantages of mechanical ventilation are many, for they permit control not only of the quantity and velocity of the air brought into the room, but also its temperature, moisture, and purity. The temperature of the air before it is introduced may be regulated by passing it over heated or cooled coils. The amount of moisture may also be regulated and the dust or impurities may be extracted by passage through filtering media. Mechanical means of ventilation are employed especially in schools, factories, theatres, and other public places where large numbers of persons gather within a room.

HEATING.

The human body may bear great variations in external temperature providing the change from one extreme to the other is not too sudden and providing the equilibrium of the body temperature is maintained by proper clothing, food, and muscular exercise. In most parts of this country during a large part of the year the temperature of the air within the rooms and houses would be too low for comfort and health if it were not raised by artificial means. There are certain hygienic demands for heating houses which may be formulated as follows:

1. There must be an equable temperature within the house, and the heating apparatus must therefore be easily regulated.

2. The heating must be continuous so that there is no sudden fall of temperature during night.

3. The heating should not add any impurities to the air in the form of dusts, smoke, or gas.

4. The temperature of the room should be between 58° and 70° F., with a relative humidity of 40 to 60 per cent.

5. The heating process should be simple and free from dangers of explosion, etc.

6. The heating should be inexpensive and accomplished with as little effort on the part of the dweller as possible.

Means and Methods of Regulation of Temperature.—As a rule no attempts are made to regulate the temperatures of our rooms by artificial means during summer. Some lowering of the temperature may be gained by preventing insolation, by window curtains, blinds, etc., by revolving electric fans, and by opening windows and doors.

The heating of rooms is accomplished by burning certain materials called *fuels*. These fuels are of many kinds, such as straw, corn-stalks, dry peat, wood, bituminous and anthracite coal, coke, oil, gas, etc.

Heating may be local or central. In local heating the fuel is burned in the room to be heated. In central heating the fuel is burned in a central location and the heat is conveyed into the rooms by means of air, water, or steam.

Local Heating.—The fuel is burned in special receptacles, either open, called grates, or closed, called stoves.

Grates.—The form of radiant heat represented in the various open grates is probably one of the oldest methods of house warming known. A large percentage of the heat, some say 88 per cent., is totally lost. The greatest objection, however, is that the heat evolved is distributed unequally, that considerable drafts are created, and that while a grate fire may look cheerful, it is neither comfortable nor adequate. There are improved forms of grates in which a greater combustion of fuel is accomplished and some of the objections to open grates are overcome.

Stoves.—Stoves made of brick or glazed tile are extensively used in European countries. In the United States cast- and wrought-iron are used almost exclusively. Iron heats and cools very rapidly and is apt to become overheated. The use of stoves is often very convenient, but is inevitably accompanied by ashes and dirt, and the need of carrying coal and wood to the stoves. The air of rooms heated by ordinary stoves is apt to be overdry and overheated.

Heating with Gas.—Gas is a good fuel for heating rooms and houses. Gas stoves must be provided with flues leading to chimneys for the disposal of odors and gases from the stoves.

Electricity.—This is an ideal method of heating, the only objection against which is its cost.

Central Heating.—The central heating of small dwellings by means of hot-air furnaces is very extensively used in the United States. As ordinarly made the hot-air furnace is a stove, usually placed in the cellar and enclosed by a sheet-metal jacket at some distance from the stove. The space between the stove and the jacket contains air, which is brought from the outside of the house by a tube or *cold-air box.*

This air within the jacket is heated by the coal in the stove, and, rising, is conducted by means of sheet-metal pipes or ducts into the various rooms of the house. The cold-air box should be made of metal and its entrance screened to prevent the introduction of dust. The hot-air ducts should be ample and have as few bends as possible. The advantages of hot-air furnaces are their low initial cost of installation, the absence of radiators occupying space within the room, and the improved ventilation by the introduction of warm air. The objections are that they often produce superheated air which is too dry and that the air often contains dust, coal gas, and smoke.

Hot-water Heating.—In this most simple form of heating a water receptacle is heated in a central location within the house, usually the cellar. This receptacle is connected with an ascending pipe leading to the upper part of the house, whence a descending pipe returns the water to the original receptacle below. In each room there may be several coils of pipe radiators connected with the ascending or descending pipes. The water in the receptacle or heater rises and circulates through the ascending and descending pipes and radiators. The temperature of the water in the system is never very high and is below boiling-point. The heat may be kept up continuously. This is the best system of house heating, especially for houses not above three or four stories in height. A hot-water system of heating costs somewhat more to install than a steam-heating plant, but it has the advantage of greater simplicity and lesser cost of maintenance.

Steam Heating.—In this system the pipes are filled with steam under low or high pressure instead of hot water. The steam-heating plant needs expert attendance, a large consumption of coal, and cannot be well regulated so as to give constant heat. As soon as the heat in the boilers is reduced below the production of vapor the pipes and radiators are suddenly cooled off. There is, therefore, usually a marked difference between day and night temperatures of steam-heated rooms. An annoying concomitant of a steam-heating system is the noise and hammering within the pipes due to the steam meeting with the condensed water from cooled-off radiators. This is called "water hammer" and is met very often. There are a number of different systems of steam heating.

The advantage of steam heating are that houses may be heated with a comparatively small installation expense, or even from a central location outside of the house, and also that houses of any size may be heated to any temperature desired. The objection to steam-heating systems are the need of specially trained caretakers, the undue heat of the steam pipes and radiators, the usual stoppage of steam at night, and the comparatively high cost in fuel consumption.

Temperature Regulation.—The degree of heat in the rooms is measured by thermometers; the degree of relative humidity or moisture in the air is measured by various hygrometers. In houses provided with a mechanical system of ventilation and heating the temperature of the room may be regulated by thermostats and the relative humidity by humidostats.

WATER SUPPLY.

Water and Health.—Water is essential to human life. Nothing in the organic world can exist without water; it is a component of everything in the vegetable and animal kingdom. Sixty-three per cent. of the weight of the human body is water. Without water life can be sustained only for a very short period.

Water is needed not only for drinking purposes, but also for cooking the food, for washing the body, for laundry purposes, for cleaning utensils, and for many other household purposes. The quantity of water needed for the various household purposes varies according to the habits of the individual and the degree of civilization. Thirty gallons of water per capita per day is a very conservative estimate, while a greater supply is beneficial.

Water, chemically pure, consists of two volumes of hydrogen and one part of oxygen. As water is a great solvent it is very rarely, if ever, found pure; it contains various ingredients taken up from the objects with which it comes in contact. Some of these are harmless, but the presence of others in drinking water may be harmful.

The impurities found in water, which may have some influence upon man, may be gases, minerals, organic matter, and microbes. The gases are those which are a component part of air, oxygen, and carbon dioxide.

Water dissolves most of the minerals with which it may come in contact, and among those which may be found in water are the following: chlorides, calcium, magnesium, iron, sulphur, and many others.

The organic matter may be of vegetable or of animal origin. Microscopic plants, vegetable fungi, detritus of vegetable life, as well as the products of decomposition in vegetable life, are abundantly found in water. Substances of animal origin found in water include minute insects, infusoria, the ova of insects, some minute parasites, suspended animal débris, products of decomposition, disintegration, and putrefaction.

The most important constitutents of water from the hygienic point of view are the microbes or representatives of germ life, bacteria, bacilli, etc. The millions of bacteria usually found in water are harmless, as a rule, but there may be some which may become a menace to health and life. These germs are called pathogenic. They are the causes of the specific diseases of typhoid fever, cholera, dysentery, diarrhea, and other similar disorders. They get into the water by various routes and means, but most commonly through pollution with animal sewage and decomposed organic matter.

Besides the impurities enumerated already, water may also contain certain poisons which it has dissolved during its course over or under the ground. The most important of these are copper, lead, zinc, arsenic, and sulphur.

Water and Disease.—The physical impurities, such as the débris of vegetable, animal, and mineral matter, which are often found in water, may be dangerous to health, because of the disturbances they cause in the digestive tract. The degree of danger depends upon the quantity, composition, etc. The chemical impurities may be found in the form of dissolved metals or gases, and include sulphur, lead, arsenic, and other toxic elements in greater or lesser quantities. The ingestion of water containing such substances may become dangerous to health, according to the amount and toxicity of these ingredients.

Certain parasites and their ova are also found in water. Among these are the ova of tapeworms, roundworms, and especially of hookworms. The terrible scourge of "hookworm disease" in the Southern States is transmitted by means of water containing the ova.

Typhoid, cholera, and dysentery have been, and are frequently caused by the drinking of water containing the germs of these infectious diseases. Indeed, these have been properly named the "water-borne diseases." The presence of typhoid, cholera, and dysentery germs in water, as well as the direct transmission of such diseases through the agency of water has been clearly demonstrated. There are also abundant data which show a marked decrease in the prevalence of such diseases whenever precautions for the prevention of contamination or for purification of contaminated water are taken.

Good water should be clear, free from sediment and suspended matter, colorless, odorless, aërated, of a pleasant taste, cool, and soft. Water is judged by its palatability, degree of hardness, turbidity, the amount and character of organic contamination, the presence or absence of metallic poisons, and the number and character of the bacteria present. All palatable water is not necessarily wholesome, nor is a water bad merely because it may be unpalatable. The taste of water depends upon the temperature and upon the presence of air and carbonic acid. As carbonic acid may be due to organic decomposition, water may be organically contaminated and still taste pleasant; on the other hand, chemically pure distilled water has an insipid taste.

The hardness or softness of the water depends upon the presence or absence of carbonate of lime, or of the sulphate and chloride. Temporary hardness is caused by the presence of carbonate of lime (chalk), which is driven off by boiling; permanent hardness depends upon the chlorides, sulphates, salts of magnesium, etc., and cannot be removed by boiling the water. Hard water, on boiling, precipitates the salts upon the side and bottom of the vessels, and thus prevents the proper cooking and softening of certain vegetables; hard water also prevents the formation of lather and the dissolving of soap in washing clothes. Except for these effects it is questionable whether hard water is otherwise injurious.

Sources of Water Supply.—There are three main sources of water supply for habitations: (1) rain water; (2) surface water; and (3) subsurface water.

Rain Water.—Rain water is the purest of all waters, unless it is contaminated by the impurities in the air during its fall, or by the vessels in which it is stored. Rain water is not very palatable because of lack of aëration, but is very good for cooking and laundry work because of its softness.

The quantity of rain water depends upon the amount of the rainfall, the periodicity of the fall, and the area of the collecting vessels. As a constant source of water supply rain water cannot very well be depended upon, and in cities in which the surface air is apt to be much contaminated, rain water is not without dangers because of the impurities it gathers during its fall. In farm houses and rural communities the collection of rain water as a supplementary source may be of benefit, provided care is taken that the tubs, barrels, tanks, or cisterns wherein it is collected are clean, free from impurities, and kept covered after the collection of water.

Surface Water.—Surface waters, like ponds, lakes, and streams, are not a very good source for water supplies, because they are easily contaminated with sewage and other organic materials which are so abundant upon the soil, especially about or near human habitations. They are principally collections of the drainage of the very much polluted surface soil and may contain any dangerous impurities, like the germs of typhoid fever and others. Large and swift rivers and very large lakes are sometimes used as a source of water supply, but even these are apt to be dangerous unless the water for drinking purposes is taken far from the shore or is purified before use.

Subsoil Water.—A large proportion of the water falling upon the ground in the form of rain or snow slowly sinks into the soil through its porous strata until it finds a stratum which is impermeable. It then collects and forms underground water reservoirs which are at a greater or lesser distance from the surface, and can be reached by digging deep enough into the ground.

During the process of percolation into the ground the water is filtered and loses some of its impurities, but in passing through the various soils it may take up certain minerals with which it comes in contact and these become suspended or dissolved in it.

The underground water basins lie sometimes at a very great depth. The water therein is in constant motion in a vertical or horizontal direction, and as the pressure is sometimes great the water may crop out at some surface in the form of springs. The water in such springs, when at a proper temperature and free from minerals, is palatable and wholesome. Sometimes these springs have considerable mineral ingredients dissolved, and are at high temperature, owing to the character of the earth's crust which the water traverses. These are the sources of "hot" or "mineral" springs.

The deep-lying underground water may be reached by driving wells into the ground into the lower impermeable stratum. Water from deep wells of this kind is very good. The water from shallow wells or those dug into the first near-surface-lying underground water basin is apt to be impure, because such wells usually tap a subsoil water, which is gained by surface drainage from localities largely contaminated with organic matter, manure, and sewage.

The privies and cesspools near habitations almost always drain their liquid contents into the sources from which shallow wells get their water, and many epidemics of typhoid and other diseases have been traced to the use of polluted shallow well water. Shallow wells are also called *dug* wells to distinguish them from deep and artesian wells, which are commonly bored or driven. Wells must be dug at considerable distances from houses and stables, and at places where no surface impurities can drain into them. They should be lined with brick and cement, or with glazed tiles set in cement, and also fitted with proper covers to prevent the falling in of filth from the outside. The water is drawn from the well in buckets or pails either worked by hand, windlass, or by means of suction pumps or other mechanical devices.

Aqueducts.—For the supply of large towns with their millions of population immense water-supply works are needed. Their construction and the supervision of the water area must be in charge of engineers.

House-water Supply.—Where there is a town-water supply system, houses are supplied from the street mains; the size of the street mains depends upon the water-pressure and the number of houses to be supplied. The branch house-water supply pipes coming from the street mains should not be less than three-quarters inch for small houses and from one and a half to two inches for larger houses. The house pipes are connected with the street pipe by "corporation taps." There should be a stop-cock under the sidewalk, and also one on the service pipe at the entrance to the cellar. Street mains are made of galvanized iron; some of the house pipes may be made of lead. The materials and workmanship of all water pipes must be of the best, and they should be protected from freezing whenever exposed.

Whenever the pressure of the street mains is insufficient to lift the water to the height of the upper stories of a house, storage tanks or cisterns must be provided upon the roof. These tanks are commonly made of cedar or cypress wood, are round in shape, and should rest upon a solid foundation, preferably upon iron beams. When located within the house the tanks are metal lined. All tanks should be provided with suitable covers, also with overflow pipes and water-waste protecting valves. The overflow may be discharged onto the roof, or lead down into the cellar and discharged into a sewer-connected, properly trapped water-supplied open sink.

In order to lift the water to the highest story some mechanical means, such as pumps, driven by gas, steam, or electricity, may be necessary.

Hot-water Supply.—Modern houses are not only provided with hot water, but provisions are also made to supply the house with hot water necessary for bathing, washing, and cleaning purposes.

The hot-water supply is derived in most houses from boilers of copper or iron, connected with the kitchen range. In larger houses special hot-water furnaces and boilers may be provided, from which the hot-water pipes go to every fixture in the house. The heating of water by means of electricity is practicable wherever there is electric power within the house. A simple device to heat water in a vessel is by means of an electrically heated metal coil placed in the vessel.

Purification of Water.—The large amount of impurities, some of them very dangerous to the health and life of the consumers, which are commonly found in drinking water render the problem of water purification an important one from a sanitary stand-point. Water purification should be twofold, public and private. Whenever the water supply is collective, public, and on a large scale, the community at large should provide for proper water purification. Whether there is a public water-purification plant or not, every individual household should provide some means of local water purification.

Methods of Domestic Water Purification.—Water may be purified for domestic use by sedimentation, boiling, distillation, chemical means, and by filtration.

Sedimentation.—Water may be freed from its coarser particles of impurities of sand and dirt by letting it stand in a vessel from twelve to twenty-four hours. This may also free the water from such organic matter and impurities as are held in suspension, without, however, clearing it of the impurities held in solution.

Boiling.—All living organic matter and germs are destroyed by raising the temperature of water to the boiling-point and by keeping it at that temperatue for a certain time. This is the cheapest and most available method of purification, and is also the most efficient. The objection against boiled water is the insipid taste which results from the expulsion of air and carbon dioxide by the process of boiling. The pleasant taste of the water may be restored to boiled water by aëration, or by charging it with carbonic acid gas.

Distillation.—This is the surest and best means of removing all impurities. It kills all germs, including all of the spores, and gives an absolutely pure water which when aërated or charged with carbon dioxide is very palatable in addition to being pure. The objection to distillation of water for domestic purposes lies in the necessity for a proper apparatus; but the time seems to be approaching when every house will be furnished with water-distilling apparatus just as it is at present furnished with a cooking range and hot-water boiler. The apparatus to be of value should be simple in construction, easily operated, durable, strong, and readily cleansible. It should furnish an adequate supply of water for all domestic purposes with little trouble and at small cost. Such an ideal apparatus has not as yet been invented, but there are a number of devices which approach it and may safely be used.

Chemical Means.—The settling of turbid water may be hastened by the addition of a few grains of alum (not more than six grains to the gallon). The addition of small quantities of potassium permanganate has a destructive effect upon organic matter. Addition of tea leaves and other vegetables containing tannin is said to reduce the danger from organic impurities, but this is problematic. Other chemicals, like borax and boracic acid, copper sulphate, etc., have been advocated, but when used in too small quantities they are of little or no value; when used in larger quantities they may become almost as dangerous to health as the impurities which they are intended to destroy.

Water Filtration.—Water may be purified by filtration, *i. e.*, by letting the water pass through some material which is capable of retaining some or all of the contained impurities. The value of a water filter depends upon the following factors:

1. The character of the filtering medium and its ability to retain and remove from the water as many impurities as possible.
2. The thoroughness of the process and its rapidity.
3. The ready cleansing of the filtering media and its ready disinfection.
4. The simplicity, cheapness, and accessibility of the filter.

It is claimed for some filters that they are able to remove all the organic impurities from the water, as well as the bacteria, but this is not yet proved. It is certainly true only of a very few filters upon the market, and of those only when they are new. Whenever water is suspected of containing pathogenic bacteria, dependence upon filters may become dangerous to health, and distillation is the only sure way of securing purity of drinking water.

The materials which are used for filtering water are sponges, wool, asbestos, sand, stone, porcelain, infusorial earth, spongy iron, magnetic carbide of iron, charcoal, etc. Sponges, wool materials, and asbestos cannot very well be depended upon; at best they act but mechanically, easily get dirty, and are difficult to clean. Sand and porous stone will arrest suspended matter; they may even remove some of the organic matter. It is doubtful whether all organic impurities and microbes can be removed by them. Charcoal is a very good filtering medium in some respects. Animal and not wood charcoal is used.

Animal charcoal is prepared from calcined crushed animal bones, and may be used in block form or in the form of a powder. Charcoal removes coloring matter and considerable organic matter from water, but does not remove all organic impurities. Charcoal used for filtering must be frequently recalcined. Unglazed procelain is used for filtering purposes and is quite effective in removing water impurities, provided the filtering porcelain is frequently cleansed, as the impurities are apt to become clogged.

Infusorial earth is used in the Berkefeld filter. It is pressed in the form of hollow tubes. The water passes under pressure through the fine pores of the filter and gains access to the tap. It is claimed for this filter that when new it will remove all organic matter and bacteria from the water. The filter is made in various forms and sizes and may be attached the the house-sink faucet. The filtering tube must be removed frequently, sometimes more than once a day, and the dirt accumulating upon the surfaces washed off, otherwise the filtering process becomes slower and slower and stops when the pores of the tubes become clogged.

Ice.—The use of frozen water in the form of ice is very extensive, and when used for drinking purposes there is the same danger of organic impurities as in ordinary unfrozen water.

As most of the ice used is obtained from the surface of lakes, ponds, and rivers subject to organic contamination, the use of ice may become very dangerous. It is best to use ice only as a cooling medium, without melting it for drinking purposes. Ice may be made from distilled or boiled water, and is then free from impurities. It has been shown experimentally that freezing does not kill the bacteria in the water. Ice-chests and refrigerators have become a household necessity. They are commonly made of wood, hard wood is best, with mineral packing in the double wall to insure non-conductivity. Within the refrigerator is lined with metal or porcelain or enamelled iron. Some refrigators are kept cold by means of electricity without the use of ice.

The waste pipes from the ice-box should never connect directly with the plumbing of the house, but should discharge into the sewer-connected, properly trapped, water-supplied, open sink. The waste pipe is sometimes provided with flap valve to prevent the entrance of warm cellar air.

HOUSE DRAINAGE.

Sewage and its Disposal.—One of the most important needs in connection with human habitations is the disposal of the organic matter and sewage due to the presence of the inhabitants. The average adult passes about 3 ounces of solid and about 40 ounces of liquid excreta, which when multiplied by the number of house dwellers forms a large amount of organic detritus. This organic matter if left exposed for some time begins to decompose and undergo putrefactive changes, evolving foul gases and odors during the process. The solid excreta may also contain a large number of germs, some of which, such as the germs of cholera, typhoid, intestinal disease, and others, are pathogenic. The organic excreta and detritus are embraced under the general term of "sewage," and unless there is proper and effective disposal they become not only disagreeable and unpleasant, because of the foul odors and gases, but, also, at times, dangerous to health and life.

Methods of Sewage Disposal.—The principal methods of ultimate disposal of sewage are the following: Cremation, chemical precipitation, land irrigation, disposal into rivers, lakes, and seas, and the various modern bacterial, septic, and biological methods.

The immediate disposal of sewage from the houses may be dry or by means of water. In isolated houses without water supply, and with a few house dwellers, the means of disposal of sewage is by pails, earth closets, privy vaults, and cesspools. When there is a water-supply system the sewage may be carried out through a system of plumbing pipes and fixtures, and be disposed of in cesspools or through land irrigation.

Pail System.—The pail system is by means of the simple expedient of gathering the solid excreta into tight pails or receptacles and then removing the contents when the pails are full.

Privy Vaults.—Privy vaults are in extensive use in this country, in rural communities, villages, farms, and in some cities which are not sewered. There are a large number of them in the outlying boroughs of New York and the outskirts of other cities.

The privy vault, as ordinarily constructed, is a hole in the ground, over which there is a raised platform with a seat, the whole covered with some sort of a shed. The privy is always a nuisance, because of its proximity to the house, of the foul odors emanating from it, the flies and insects it attracts, the contamination of surrounding soil, and the possible pollution of near-lying wells and water courses.

This pollution of the water and of the soil is the greatest objection against privy vaults. These privies remain in the same place so many years that the soil beneath them becomes a veritable sewage lake from which contamination of the surrounding soil and of the water supply nearby results. The diseases which may be due to such soil pollution are typhoid fever, hookworm, dysentery, tapeworm, etc. In the South the terrible ravages of the hookworm disease are due mainly to soil pollution and unsanitary privies.

The principal parts of a privy are the shed, the seat, and the receptacle into which the excreta are dropped. The shed in a sanitary privy should be made of tightly fitted boards, with windows properly screened and doors well closed in order to prevent insects and flies from gaining access. The seat should be so arranged as to be convenient for use, and should be free from contamination of excreta. The receptacle or the place into which the excreta are dropped should be more than a mere hole in the ground, from which the liquids percloate into the surrounding soil, and in which the excreta remain and decompose; it should be made water-tight by being lined with cement or some non-absorbent material. The excreta when dropped into this water-tight receptacle will remain there and must be removed from time to time. A still better method is to place in such water-tight receptacles a tight portable pail which is hung on a hook from the seat. The excreta are dropped directly into the pail, which may be removed as soon as it fills, and the contents cremated or disinfected, the pail cleansed, washed, and disinfected, and returned to its place. For the purpose or removing these pails and cleaning the vault beneath the privy each part of the privy should be made with a sling cover so as to be accessible.

Cesspools.—These may be used when the house is provided with fixtures and pipes to carry the sewage out, and to collect it in a cesspool at a point distant from the house. The so-called "leeching" cesspools, which are not water-tight and allow liquids to drain into the ground, are open to the same objections as privy vaults. When cesspools are water-tight, they must be emptied at periodical intervals or provided with automatic ejectors and siphon apparatus to discharge their contents. The best mode of discharge is by means of a system of intermittent filtration, or subsoil irrigation. The sewage is emptied into earthenware pipes with open joints, which lies several feet under ground and radiate in different directions, through land to be irrigated. The liquid sewage drains into the ground at the joints and is effectively disposed of, enriching the land.

The Water-carriage Method.—This method is now extensively used in cities and towns where sewers are built. It is the best means of disposing of the liquid and sewage contents of houses and streets. The sewage from the sewers is either collected and led to the ultimate disposal works, or is carried into the sea and water courses.

There are two methods of sewering houses by water carriage. In the *combined* method not only sewage proper is carried away through the plumbing pipes and the street sewers, but also all other waste waters, and especially all rain water collected from the roofs. In the *separate* system the rain water is disposed of by means of separate pipes, and the sewers proper carry away only the liquid and solid waste matters from the house itself. In the separate system the pipes are smaller, and thus decrease the expense of the plumbing; on the combined system the pipes must be large enough to discharge the sometimes enormous amounts of storm water. The combined system is the one used more extensively.

Street sewers are constructed by the municipalities and are made of brick, earthenware, and iron. Every house connects with the street sewer by separate house sewers.

PLUMBING.

Materials.—The plumbing system of the house consists of receptacles (or as they are termed "fixtures") which receive the various forms of house waste, and of pipes connected with these fixtures, by means of which the waste matter is carried into the street sewer. As the pipes carry waste water and at times considerable quantities of gas, the materials from which the pipes are manufactured must be strong, durable, and *water-* and *gas-tight*.

The earthenware or "clay" pipes which were formerly extensively used for house drains and house sewers are objectionable. They are obsolete now, and most municipalities have prohibited their use within the house and limited them to the short lengths needed for house sewers, outside of houses, when they are laid on rocky or solid ground. The only advantage of earthenware is its cheapness; but, on the other hand, its brittleness is such that it is impossible to make gas-tight drains to withstand any long and constant use. Earthenware house drains are veritable channels of filth, emitting foul and offensive odors.

Lead.—Lead is quite extensively employed in the manufacture of piping. It has some advantages in its ductibility, but the pipes are heavy, expensive, and easily injured by nails driven into them, by being gnawed through by rats, etc. The use of lead is limited to short lengths of pipe, to branch waste pipes and to small-caliber water pipes.

Iron.—The material which is almost universally used for pipes is iron; it has all the advantages of cheapness, hardness, durability, and tightness.

Brass.—Brass, nickel, and other hard-metal pipes might be used were it not for the expense. Glass is a good and appropriate material for piping, and when its manufacture is perfected it will probably be used extensively.

Joints.—The proper joining of the several lengths of pipe used in the house is of great importance, as otherwise the system cannot be made gas-tight. Earthenware pipes are joined by means of cement. Lead pipes are joined by means of solder-wiped joints. Cast-iron pipes are joined by means of lead-calked joints. Wrought-iron and brass pipes are joined by screw joints. Lead pipes are joined to iron pipes by means of brass ferrules.

Pipes.—The plumbing system within the house consists of several pipes—vertical and horizontal.

Vertical Pipes.—The vertical pipes are the following:

The Rain Leader.—This carries down the rain water from the roof into the house drain.

The Waste Pipe.—This carries down the waste water from kitchen sinks, wash-basins, laundry tubs, etc.

The Soil Pipe.—This is connected with the water closets and, usually, with the bath tubs, and carries down the sewage and waste from these.

Horizontal Pipes.—*The House Drain.*—This is the principal horizontal pipe. It connects with all the vertical pipes and carries away the whole house-waste matter into the street sewer.

House Sewer. This name is applied to the short length of drain a few feet outside of the house foundations which leads to the connection with the street sewer. It is really a part of the house drain.

Sizes.—The sizes of the various pipes should correspond with the amount of waste matter they are supposed to carry. There is no advantage in making the pipes too large; smaller pipes are apt to be better flushed than larger pipes. A two-inch waste pipe with only two or three fixtures attached to it ought to be sufficient for a private dwelling. The New York rules require a four-inch pipe in tenemant houses where five or more sinks are used. Three- and four-inch soil pipes are adequate in private dwellings; five-inch pipes are required in tenemant houses with five or more water closets. Branch waste pipes vary from one and one-half inch for basin and laundry tubs to two-inch pipes for other fixtures; branch soil pipes should not be less than four inches in diameter. House drains and house sewers are from four to six inches in diameter, according to the number of fixtures in the house. The six-inch drains, invariably demanded by municipal authorities, are sometimes entirely too large to be properly flushed.

Sewer Air.—The materials of which pipes are made should be perfectly water-tight, to prevent any leakage of the sewage and waste fluids. The pipes should also be *gas-tight,* because the gases generated within the pipes are believed to be undesirable for the inhabitants of the rooms in which the plumbing pipes are situated.

The plumbing system connects the house with the street sewer, and the same pipes which serve to rid the house of liquid waste and sewage matter become, reciprocally, a direct means of entrance for the air and gases in the street and house sewers to the house and rooms. Is this desirable?

There is still a great deal of misapprehension of the common terms sewer gas and sewer air. The popular idea of sewer gas is that it is a distinct *gas*, something like illuminating gas, which is found only in sewers and plumbing pipes, and that its inhalation is harmful to a great degree. There are some, indeed, who believe that sewer gas is capable of producing certain diseases like typhoid fever, diphtheria, etc.; and not so long ago a prominent sanitary inspector asserted that she traced several cases of tuberculous meningitis to defective pipes under sinks. The theory that sewer gas causes various diseases was once upheld by noted sanitarians, and seriously advocated by Drs. Simon, Richardson, Gorfield, and others equally prominent.

As a matter of fact, later research has shown that there is no such gas as sewer gas. What is termed sewer gas is but sewer air, and there is no more reason to term the air in a room "room gas" than the air of sewers "sewer gas." The sewer air may at times be as pure, and more so, than the air of rooms, and, at other times, it may contain the same or more impurities than room air.

The impurities ordinarily found in sewer air are an excess of carbon dioxide, carbon monoxide, illuminating gas, sulphuretted hydrogen, marsh gas, ammonia, and other gases found wherever decomposition and putrefaction takes place; there may also be found a large number of bacteria and various microörganisms. This composition of air which at times may be found in sewers, while not liable to directly cause various diseases, is certainly not desirable as an additional mixture to the air in our rooms, air which, without any additions, is rich in impurities. There is no doubt that the inhalation of impure sewer air is injurious to human beings, in the same manner as is the inhalation of any impure air, and therefore it is imperative to prevent the incoming of air from sewers into the house and rooms.

Traps.—As there is a direct connection of the rooms with the sewer in the house-plumbing system, the problem is how to disconnect the house from the sewer and at the same time leave the plumbing system to perform its functions?

The problem is solved by means of traps.

A trap is a bend in a pipe, so constructed as to retain a certain amount of water. This water is called *seal*, and serves as a barrier to the backflow of air from the sewer into house pipes. Traps are especially constructed in them, and thus cut off communication between sewer and house.

The house is disconnected from the sewer by the main trap on the house drain. This serves as the principal barrier to the inflow of sewer air into the house, but there are also additional traps on the branch pipes under each and every fixture which serve to prevent the bad air in the house pipes from coming into the room from and through the fixtures. Thus there are a main trap, the house-drain trap, and a multitude of fixture traps. The traps are made in various forms, and have innumerable names and shapes, but all are intended to serve the same purpose. There are also a number of mechanical traps with various devices for strengthening the action of the trap as a *seal*. Of course, as everywhere in plumbing, the simpler the contrivance the better it is. The most commonly used traps are the "running trap" on house drain and the "S" traps on fixtures.

Loss of Seal.—The traps can be depended upon only as long as their *seal, i. e.*, the water in them, is intact; but if, for any reason, this seal is broken or "lost," it is evident that the trap becomes useless. There are a number of causes, such as evaporation, momentum, capillary attraction, siphonage, and, perhaps, back pressure, through which a trap may lose its seal and thus become ineffective as a barrier to sewer air.

Loss by Evaporation.—The water in a trap may evaporate if the fixture over the trap is not used for a long time; hence, house dwellers may find the houses they left for the summer full of bad air on their return, owing to the loss of seal. This evaporation can only be prevented by frequent use of the fixture, or by filling in the traps, before leaving and closing up the house, with some oil or other non-evaporable material.

Loss by Momentum.—Loss of seal by momentum is due to negligence in pouring into a fixture a large amount of water, suddenly and forcibly, so that the momentum is insufficient to empty the trap as well. This can be prevented only by care.

Loss by Siphonage.—A more important loss of seal occurs through siphonage. The water in the trap or seal is suspended between two columns of air, and is influenced by any and all currents of air on either side of the seal. A discharge of water from a large fixture connected with a vertical pipe acts like the drawing of a cork or piston through the pipe, *i. e.*, it creates a vacuum behind it, causes great suction, and draws out, or "siphons" out, any water which may be in the trap.

By "siphonage" is therefore meant the emptying of the seal of the trap by the aspiration of the water in the trap as a result of the downward rush of water in the pipes with which the trap is connected.

The siphoning of traps is a frequent occurrence in large houses in which the water from fixtures in the top floors has a distance to travel and falls with great momentum. Every discharge of a water closet on a top floor will siphon out the seal of the traps of sinks and wash-basins on the lower floors.

Loss by Back Pressure.—This happens in house-drain traps during big rain storms when the street sewers are overflooded, and part of the overflow backs up into house drains where it may force back the water of the main trap. It may also occur during a rise of tide in houses near the shore. What is ordinarily understood by back pressure, however, is the absorption of foul gases by the water in a trap from the air in the pipes. As the water is exposed continuously to the gases in the pipes this absorption goes on all the time, and thus the gases may enter the room through the water in the traps.

Vent Pipes.—The prevention of the siphonage of traps, as well as of the back pressure, has occupied the minds of many plumbers, and various means have been employed to remedy the evil. A number of mechanical traps have been invented, but they all have the one fatal defect, that they are cumbersome and do not prevent the evil they intend to remedy.

Actual backing up of water in main traps can be prevented by the tide valves. There are a number of these on the market, and most of them serve their purpose well.

The back pressure, which consists of the absorption of gases by the water in traps, can very well be prevented by a good ventilation of the pipes. This is readily accomplished by the ordinary extension of the vertical pipes above the roof and by the fresh-air inlet.

The siphoning of traps in houses of two and three stories, in which the fall of water is not so heavy and the momentum consequently not so great, can be prevented by the "non-siphoning" traps.

It is only in large houses, tenements, factories, etc., that the problem of siphonage demands the installation of a new system of pipes called "vent-" or "back-air" pipes. These run vertically through the houses, and by their branches join all the traps near their crown and thus furnish a column of air for the water seal in the traps. This air prevents siphonage because it is more easily withdrawn during the aspiration process than the heavier water in the traps.

The vent-pipe system serves also as an additional means of ventilating the whole pipe system. The objection against the venting pipes is the additional expense. While most municipalities strictly demand vents in all houses, there is reason to believe that the practice of installing a special vent system will not last very long, especially in private dwellings. At present the tendency is toward simplification of the pipe system of the house. In the so-called "one-pipe system" of plumbing the vent pipe is omitted, and siphonage is prevented by the installation of "non-siphoning" traps.

PLUMBING PIPES AND FIXTURES.

The plumbing system consists of the various fixtures, such as sinks, wash-basins, laundry and bath tubs, and the water closets. All these fixtures lead into the three main vertical pipes within the house, viz., *waste* and *soil* pipes, with the *vent* pipes accompanying them. All the vertical pipes in turn lead into the horizontally running main *house drain* which connects with the street sewer through the short house sewer.

House Drain.—The house drain is the main pipe. It receives all the drainage from the vertical pipes in the house and carries it to the street sewer.

The house drain is not level, but has a *pitch* or *fall*, in order to assist the velocity of the flow of its contents. The rate of fall should not be less than half an inch to the foot, although some municipalities allow a fall of a quarter of an inch to the foot. The rate of the fall depends also on the diameter of the pipe.

The position of the drain under the house should be above the cellar; on the cellar floor, or under the ground. There is the greatest objection to the placing of any plumbing pipe out of view; especially is the general practice of hiding the house drain under the cellar floor very bad, as it conceals the frequent defects of construction, joints, etc., and is likely to cause great damage to the cellar and foundations by saturating them with offensive effluvia before the defects are detected. When the house drain runs above the cellar it should be properly supported, either by brick piers or by suitable hangers to the wall. When it runs on the cellar floor the house drain should rest in specially constructed concrete or cement beds, and in trenches with proper beds for the hubs.

The house drain is separated from the house sewer by the main house trap, which is situated near the inside house wall. It should be provided with hand holes for cleansing purposes, and with tide valves when there is a possibility of back pressure by tide or storm. These hand holes should be closed by brass screw ferrules.

The fresh-air inlet is a cast-iron pipe about four inches in diameter. It enters the house drain on the house side of the main trap, and extends to the outer air at or near the curb, where, as a rule, it terminates in a receptacle covered by an iron grating in the sidewalk. This form of fresh-air inlet is almost always ineffective, because the iron grating and the fresh-air box are commonly full of rubbish and dirt. The extension of the fresh-air inlet pipe several feet above the ground, properly protected by a wire basket or otherwise, and placed at a distance of at least fifteen feet from windows, is preferable to the ordinary fresh-air box.

The Soil and Waste Pipes.—The soil pipes receive the sewage from the water closets and the bath tubs which are commonly located in the water-closet apartments.

The soil pipe is made of heavy cast iron, with lead-calked joints, and is three or four inches in diameter in small houses and five inches in tenement houses and larger buildings. The soil and waste pipes should never be built in the walls, but should be exposed throughout their whole length, so that they can be inspected at all times and that defects may be seen as soon as they occur. If the pipes are gas-tight there is no reason to fear their exposure. With proper bronzing or painting they need not be artistically more objectionable than exposed steam pipes. Specially built shafts in which the pipes are sometimes placed must be made wide enough to allow entrance, inspection, and repairs.

The *waste pipe* is the pipe to which sinks, laundry tubs and basins are connected. It is of heavy cast-iron with lead-calked joints, and varies in diameter from three to four inches.

Waste and soil pipes should not end in the house, but should be extended open above the roof, at least two feet above every coping. As the extension must be at least four inches in diameter, two- and three-inch waste pipes will have to be increased to four inches in the extension pipe above the roof. Pipes of larger diameter should run above the roof.

Branch soil and waste pipes run from the various fixtures to the main soil and waste pipes, join with "Y" branches, and are of lead when less than four inches in diameter and of iron when four inches and above. Branch waste pipes from basins, sinks, and tubs are usually one and a half inches and two inches; branch soil pipes of water closets are three inches and four inches (in New York not less than four inches). The traps on the branch soil and waste pipes are not more than two feet from the fixture, and are provided with a screw cap for cleansing purposes.

Vent pipes and branch vents are of iron. The size of main vent pipes depends upon the number of fixtures with which they are connected. The main vents either run above the roof or join the vertical pipes above the fixtures.

Rain leaders serve to collect the rain water from the roof. They are made of galvanized or cast iron, or of sheet metal. The vertical pipe only is trapped at its base before connection with the house drain. The ostensible purpose of this trap is to prevent sewer air from escaping into the rain leader and entering the rooms near the windows of which the rain leader runs. As the trap of the rain leader is frequently empty, owing to evaporation during draughts or freezing during winter, and as the rain leader is situated outside of the house, there does not seem much reason for its being trapped.

Fixtures.—Sinks, wash basins, laundry and bath tubs are made of various materials. From a sanitary point of view the worst material is wood, which was formerly much used; zinc or copper lining is not much better; somewhat better is cast iron. The more modern fixtures are invariably made of enamelled iron, which is smooth, durable, and sanitary in all respects. Porcelain fixtures are more expensive, but their advantage over enamelled iron when properly made is small.

Bath tubs are commonly in the same room with water closets. They are connected with the soil pipes several feet below the water-closet connection, and if not vented the traps are apt to be siphoned by the discharge of the water closets.

The overflows from bath tubs and basins should be connected on the inside of the trap on the same fixture. Standpipe overflows are preferable to fixed ones.

Refrigerators should not be directly connected with the plumbing system of a house, but their waste pipes should be made to discharge into properly trapped, sewer-connected, water-supplied open sinks.

The sediment pipes of kitchen boilers should be connected with sink traps on the inlet side, and should be provided with faucets. It is still better not to connect them with the pipes.

All fixtures should be separately trapped, except that one trap is permitted for (several not more than three) laundry tubs, and one line.

WATER CLOSETS.

Water-supplied fixtures of some sort or other for the receiving of fecal matter have been in use for many years. Unfortunately the type of the fixtures which have been extensively used until lately embodied many defects which made them unsanitary. Of the older fixtures it is sufficient to name the so-called "pan water closet," the "plunge closet," the "school sink," the "long hoppers," the "wash-out closet," etc.

Modern Water Closets.—These are made of baked clay or porcelain, with an enamelled and smooth surface, trapped and bolted in one piece, and so arranged that the excreta drops into the receptacle, always containing water, from which the soil is properly flushed out and the whole cleaned out every time it is used. The value of these fixtures depends not only upon their shape, but also upon the methods of their flush and the abundant supply of water. Formerly the water closets were flushed directly by a pipe connected with the fixtures. This, however, was found to be defective by reason of the insufficiency of the volume of water furnished. The method used at present is the flushing of these fixtures by means of a separate flush tank placed at least four to six inches above the fixture. These tanks hold from three to five gallons of water, are connected with fixtures by flush pipes of one and a half inch in diameter, and are emptied by the pull of a chain. In some public places these tanks are so arranged that they automatically discharge their contents at certain intervals. The added cost of the flush tanks has caused various devices to be invented, with the view of eliminating their installation. There are a number of efficient "flushometers" which are used for this purpose.

Water-closet Apartments.—The undesirability of placing the water closets in the yard has already been mentioned. It is unnecessary to add that the water closets should never be placed in cellars. There are also grave objections against water closets in halls, which are frequently found in tenement houses. In office or public buildings there is perhaps no reason why the water-closet apartments should not be located in a separate compartment in the hallways, but in tenement houses this is objectionable on account of the neglect of the fixture if responsibility is divided and each tenant has not his own separate fixture.

Wherever the fixture is placed, there are several requirements which ought to be absolutely adhered to; these are the following: Sufficient space, plenty of natural light by adequate window space opening into the outer air, provision for artificial light, provision for beating in cold weather, smooth and non-absorbent walls and ceilings, a floor of cement, concrete, slate, tile, or any other non-absorbent and readily cleansible material. If in addition there is separate entrance from the private hallway, and the apartments are placed at some distance from bed rooms and living rooms, the least objectionable, most advantageous location and construction of these necessary, though sometimes offensive, conveniences is obtained.

HOUSE WASTE MATTERS.

Waste Matter: Rubbish and Garbage.—A large amount of various waste matter is found in the house, such as newspapers, rags, wool, and cloth remnants, pieces of clothing, rags, detritus of wood, stone, and other articles; also remnants of foodstuffs, cooked and uncooked meats and vegetables, etc.

Some rubbish may be harmless, but it may become a vehicle and carrier of dust, dirt, and possibly pathogenic germs. Remnants of cloth and rags may be saturated with organic matter, or contain insects and parasites, as well as ill-smelling and foul organic material.

Garbage, consisting of remnants of foodstuffs, is apt to putrefy and decompose, to attract insects and rats, to emit foul odors, or it may contain dangerous microörganisms.

Waste Water and Sewage.—This consists of the water used in washing dishes, clothes, vegetable and animal food, and in cleaning; of waste water from baths, etc., and also of liquid and solid excreta.

In houses provided with modern water-carriage plumbing systems most of the waste water and sewage is effectually disposed of by being carried away into the house and the street sewer and flushed by copious discharges of water. Whenever houses are without a system of plumbing, accumulation of the waste matter may become dangerous to health on account of decomposition and foul odors and the presence of microörganisms.

Gases and Poisons.—The character of the various gases and poisons which may be found in houses vary, but the most common are the following: Carbon dioxide, coal gas, carbon monoxide, illuminating gas, smoke, "sewer gas," and of the poisons the most common are arsenic, lead, antimony, etc.

Carbon Dioxide.—Carbon dioxide is a constituent of the air in the proportion of 3 or 4 volumes in 10,000 volumes, but in some ill-ventilated rooms the amount of carbon dioxide may reach from 20 to 50 times the normal amount. There is comparatively little danger to health from carbon dioxide unless it is present in excessive quantities.

Carbon Monoxide.—Carbon monoxide is a constituent of illuminating gas and comes into the house from various defects in the gas pipes and fixtures through which the gas may escape. The inhalation of even minute quantities of illuminating gas is injurious, and may cause headache, anemia, etc. The inhalation of large quantities may cause death by suffocation, as the carbon monoxide combines with the hemoglobin of the blood. The escape of illuminating gas is also a frequent cause of fires and explosions which endanger property and life. Carbon monoxide is also given off by imperfectly burning illuminants, by charcoal burning, and by imperfect heating arrangements and imperfect combustion of coal, as well as by iron stoves which are allowed to become red hot.

Smoke and Coal Gas.—Imperfect combustion of wood and coal produces smoke and coal gas. Their presence is also due to faulty chimneys, back draught from flues, partial closing of dampers, etc. Smoke causes inflammations of the conjunctiva, headaches, nausea, ill-feeling, vomiting, and in large quantities, suffocation.

Sewer Gas.—As already indicated, what is commonly called "sewer gas" is only the air in sewers and plumbing drains and pipes. It may be entirely free from any deleterious matter, but frequently contains various gases, such as ammonia compounds, marsh gas, sulphuretted hydrogen, etc., which arise from the decomposing organic matter within the pipes. The effluvia escape through defects in the plumbing system, and their harmfulness depends upon their quantity and character.

Poisons.—Wall paper colored with poisonous dyes is the most common source of the various poisons which may be found in the air of rooms. Minute particles of the wall paper floating in the air, the rubbed-off coloring matter adhering to dust, and scraped-off débris from painted surfaces may all contain arsenic, antimony, lead, and other poisons. Numerous cases of arsenical poisoning by wall paper have been reported, and in some countries, notably France and Germany, the use of arsenic for coloring wall paper is prohibited by law. Lately, Nephe tried to prove that poisoning by arsenical paper is not due to the dry dust, but to the volatile organic arsenical compound produced in the moisture present by the action of certain moulds on the paste used to attach the paper. Most American manufacturers of wall paper claim that no arsenic or other poisons are used at present in the manufacture of wall papers.

The presence of lead may be due to the dust from lead-painted walls and surfaces.

Dust and Dirt.—Dirt and dust may be organic or inorganic, coarse or fine, and generally consist of fragments and particles of earth, soil, clay, stone, brick, wood, lime, plaster, hair, wool, animal and vegetable matter, ashes, pulverized excreta of animals and insects, dried sputum and discharges of the healthy and sick, pollen of flowers, pulverized wool, cotton and silk fabrics and clothes, moulds, fungi, and saprophytic and pathogenic germs.

The street and the outside of the house contribute a large part of the house dirt and dust. Some of it gains access through open windows and doors or other openings, but most of it is brought in by the dwellers on their clothes, skirts and shoes.

It is, of course, useless to preach against the common habit of not discarding in the house the shoes worn in the streets and fields. These shoes carry manure, organic refuse, moist and dried excreta of man and animals, moist and dry discharges from the sick and well, sputum of consumptives, and millions of germs. Why such receptacles, laden with germs of disease, should not be left behind when coming into our "sweet homes," as is done by the "benighted" Orientals, is a question the answer to which is vainly sought.

It is also useless to decry the equally unhygienic habit of women of wearing trailing skirts which drag along and sweep up the pavements of the streets and sidewalks as well as the gutters, gathering the rich harvest of the same dangerous matter and bringing it into the house.

The house itself is a source of dirt and dust. Fragments of walls, floors, and ceilings, various objects like furniture, plants, flowers, also the various processes carried on within the house, such as sewing, cooking, lighting, heating, etc., all furnish their quota of the dirt falling upon the various surfaces of the house, and of the dust floating around in the air and settling upon various objects.

The most important source of dirt and dust is, of course, man himself. Dirt and dust are brought in by persons upon their clothes and bodies. Considerable filth is due to the discharges from animals and human beings, and a very large part of the house dirt is due to the filthy habit of expectoration.

In his booklet on *Dust and its Dangers,* Dr. Prudden expresses himself in the following forcible manner about expectoration: "The spectacle of the well-dressed, filthy brutes, whom natural selection has most unkindly left but a few degrees higher than their congeners in the sty, wallowing in their expectoration, about certain hotels and theatre entrances, may well impress the sensitive onlookers with the colossal task which nature undertook when she set to work to evolve man, and the lamentable failures which are so often but half-concealed in fashionable attire."

The Dangers of House Dust.—The character, the quantity, the sources of the dirt and dust as well as the individual susceptibility and healthy condition of the house dweller are all determining factors in the amount and intensity of the danger to health and life.

The inhalation of dust is injurious to the mucous membrane of the nose and throat, and may cause inflammation and catarrh of the respiratory tract. Dust consisting of the scales from the skin of persons suffering from measles and scarlet fever is apt to produce the same disease in healthy persons coming in contact with it.

The greatest danger from dust comes from the pathogenic germs which adhere to it. They come from the dried sputum, skin scales, and other discharges of infected persons which contain the specific microbes of various specific diseases. The dust containing tubercle bacilli from the sputa of consumptives, the dust containing the germs of typhoid fever from discharges of typhoid patients, and the other microörganisms from the many infectious and contagious diseases are, of course, very dangerous and capable of producing those diseases in healthy persons either by inhalation, or by ingestion through food. That such infectious germs are abundantly found within the house has been proved by the experiments and investigations of many hygienists.

In many houses, especially those which are damp, there are found a number of low moulds, mites, and fungi, some of which are dangerous to health. Among the most important of these is the fungus of "dry rot," "Hausschwamm, or Merilius Lacrymans," which is found in damp houses.

The organic matter which is abundantly found in the dirt and in the superimposed layers of dust upon all surfaces within the room is dangerous to health because of the putrefaction and decomposition going on within it, because of the foul and disgusting odors emanating from it, and also because of the various pathogenic germs which may be found in it.

When horse manure is a part of the organic dirt of the house it may contain tetanus bacilli, which may lead to infection with that dread disease. Also abundant organic matter, especially in dark and damp places, attracts rats and insects.

Domestic and Other Animals.—Domestic animals are often a source of danger. The common pets are dogs, cats, birds, and more rarely, rabbits, squirrels, monkeys, etc. The sources of danger to health from the animals are (1) in their excreta, (2) from the parasites living upon them, (3) from the dirt and germs which they may carry in upon themselves from outside, and (4) from the diseases with which the animals themselves may be afflicted.

Among the diseases of domestic animals which may be transmitted to man are ringworm, favus, scabies, tetanus, anthrax, glanders, actinomycosis, "psittacosis" (a pulmonary disease of parrots), influenza, diphtheria, plague, etc.

Rats are not exactly domestic animals, but they may infest houses and become a veritable pest. Their presence is favored by the construction of the house, which leaves a hollow space between the walls and floors and by the food and drink which tempt these voracious animals. Rats have been proved to be very dangerous as carriers and transmitters of plague, and probably other diseases. Their excreta deposited in foodstuffs may cause intestinal infection in man. Fleas and other parasites of rats may be carried to the human inhabitants and may infect human beings with plague and other diseases with which the rats may be afflicted.

Insects.—Houses harbor a number of uninvited guests, who not only make the lives of their host miserable, but may even become a source of grave danger. Besides rats and mice, the most disagreeable of the uninvited guests and pests are the various insects with which some or most of the houses are teeming. These insects are the following: Roaches, water-bugs, beetles, centipedes, spiders, lice, fleas, bed-bugs, and last but not least, the mosquito.

The very presence of these insects is disagreeable, either on account of their repulsive looks, or of their odors, or because of their bites. Moreover, the mode of feeding of most of these insects is objectionable to the human dwellers, who themselves are the hosts that furnish the sustenance.

Relation of Insects to Disease.—Many of the insects in the house may become agents in the transmission and carrying of disease. The mode of propagation of disease by insects is by (1) transmission, (2) direct inoculation through their bites, and (3) by becoming the intermediate hosts of some infectious germs.

Transmission.—There is little doubt that insects can transmit disease germs by means of their bodies, legs, wings, etc., which may come in contact with the food, clothes, and skins of human beings. Thus, they disseminate disease directly from one person to another. Flies, on account of their prevalence and their habit of coming in contact with excrementitious materials outside of the house and with the food and drink inside of the house, are the most active agent in disease dissemination.

Inoculation.—That certain insects by their bites inoculate human beings with the germs of diseases from which they themselves suffer has been surmised by many scientists for a long time, but definite proof of this has only lately been obtained in the matter of the transmission of plague in which the role of fleas, bugs, and rats is prominent.

Intermediate Hosts.—Some insects become the intermediate hosts of certain specific and dreaded infectious parasites, which must pass through an intermediate stage in insects before they develop into full-grown parasites capable of infecting human beings. The mosquito, which has been proved to be the cause of malaria and yellow fever, diseases which count their victims by hundreds of thousands, is a notable example.

HOUSE CLEANING.

The presence in the house of so many and such varied impurities so dangerous to health and life, makes the problem of their prevention, their removal, and their destruction an important task.

The war waged by the house dweller against all kinds of impurities must be remorseless, constant, thorough, and exhaustive, for if but a short armistice is granted the enemies of mankind are likely to get the upper hand and increase to an extent which makes their final dislodgment most difficult if not impossible. The methods of warfare against house impurities are threefold, aiming at (1) the prevention of the admission of filth, organic matter, etc.; (2) cleaning and removing impurities from the house; (3) the destruction of infectious materials.

Prevention.—To prevent the accumulation of waste matter, paper, rubbish, etc., such stuffs should immediately be collected in closed receptacles and cremated. This may be done in ordinary stoves, ranges, and furnaces, or in special furnaces for the purpose, which should be more extensively introduced. It will surprise some housewives to learn how easily they may get rid of most of the house waste, as well as the garbage, in a well-constructed furnace, and how much this assists in keeping the house clean.

Waste water and sewage are disposed into the plumbing system with which each house should be provided. In rural communities, in which no sewer system is provided, the sewage and house-waste water may also be sent into a house-plumbing system, which empties into cesspools, or, better, into land irrigation. When no system of house plumbing exists, all waste water may be sent through rubber pipes into the kitchen garden, and the solid sewage may be collected in earth closets and used later as fertilizer.

The removal of the sources of danger coming from various deleterious gases and poisons consists in the proper construction of the house, its sanitary conveniences, and its proper maintenance. Ground air from the cellar may be prevented by a thorough isolation of the house foundation from the soil by means of damp-proofing materials, and also by a proper ventilation of the cellar. Leaks from illuminating gas pipes and fixtures may be prevented by a proper and good construction of the pipes and fixtures, and by periodical inspection and care, also by periodical and frequent tests of the whole system.

This also applies to the plumbing pipes and plumbing fixtures. The pipes and fixtures must be properly constructed, all joints made gas-tight, the whole system frequently inspected, and periodical tests made to detect defects and leaks. Hand holes of traps and screw caps of traps should be uncovered and the traps cleaned out, and all sink and wash-basin traps and pipes cleaned once in a while by solutions of caustic soda or potash.

Smoke and coal gas may be kept from entering houses by a proper construction of the heating and cooking stoves and furnaces, by the skill in feeding them with proper fuel, by the care of chimneys, flues, and dampers.

The best prophylaxis against arsenic and lead and other poisons in the house is the disuse of papers and paints containing those poisons as ingredients and the substitution of papers and paints free from toxic elements. There is really no justification for the use of any materials of which some ingredients may become dangerous to the house dwellers.

The prevention of dirt and dust within the house is one of the most important sanitary measures. With proper care in construction and maintenance there is no reason why it should not be possible to make houses dustless and dirtless.

With the installation of an ideal system of mechanical ventilation it is possible to eliminate all the dust coming into the house through windows and openings. These may then remain closed, and all incoming air may be filtered and passed through appropriate materials which will intercept all dust and leave the incoming air pure and dustless.

Until the question of discarding the shoes worn outside before entering into a house, and the even more difficult one of women's skirts is settled, some substitute prophylactic measures must be provided, such as special vestibules in houses, with some mechanical means of cleaning shoes and brushing off skirts. There is no inherent difficulty in the construction of such mechanical cleaners, and their installation would do infinite good and prevent much harm.

Other means of preventing dirt and dust are the proper hygienic construction of house interiors, and the elimination of certain dust- and dirt-gathering objects within the house. The elimination from the house in all dust-gathering objects is absolutely necessary. Thus carpets, rugs, curtains, soft stuffs, upholstered furniture, wall paper, and all other dust-gathering and retaining materials and objects must be removed and kept out if the house is to be rendered dustless.

Moulds, germs, mites, fungi, and bacteria will also disappear from the house if these preventive measures against dust and dirt are universally adopted. The additional precaution of keeping the house dry and well-aired will further diminish the presence of these impurities by removing the conditions of life favorable to their growth and development.

The keeping of domestic animals within the house is incompatible with hygienic housekeeping. The ordinary precautions of bathing and washing them and of consulting veterinarians in case of sickness may diminish the dangers, but will not entirely eliminate them.

The prevention of the rat and mice pest is a more difficult problem, for these animals do not wait for an invitation to enter houses. The solid construction of walls and floors, the proper construction, lighting and ventilation of cellars and pantries, the immediate cremation of all garbage and organic matter used by them as food, the absolute cleanliness of kitchens, the keeping of food in tight receptacles, the use of rat traps, and periodical inspection and cleaning of the house are some of the methods of preventing the living of rats and mice in the house. If these measures fail, war-like methods, like poisoning and periodic fumigation with sulphur, must be adopted.

The prevention and eradication of house insects is no less difficult. Beetles, water-bugs, cockroaches spiders, and similar insects may be eliminated from the house by the following means: By measures against house dampness and the maintenance of the dryness of the kitchen floors, walls, and cellars; the construction of floors and walls without cracks and crevices, the absence of any hiding and dark places for the habitat of insects; the frequent inspection, periodic and thorough cleaning of all rooms, and, especially of those in which the presence of the insects is noticed; the dusting of surfaces where some of these insects live with borax, boracic acid, or some other antiseptic and germicide; and finally, as in the case of rats and mice, periodic fumigation.

Fleas and lice can be eliminated by the removal of domestic animals, by removing carpets and similar objects, and by the absolute cleanliness, in body and clothes, of the inhabitants.

The elimination of the noxious bed-bug is difficult. It needs eternal vigilance on the part of the housekeeper; it needs absence of cracks in walls and floors, the more extensive use of light, airy, single, metal bedsteads and light, easily handled mattresses; it needs periodic inspection, thorough cleaning, and occasional fumigation.

The elimination of the fly demands proper screening of windows and doors; covering of all foodstuff with wire-mesh covers; the keeping of kitchens and dining-rooms in a proper and clean condition, free from scraps of food, garbage, and organic matter; and constant warfare by cleaning, disinfection, fumigation, etc.

The ravages of the mosquito must be prevented by draining all marshes and standing water near human habitations and towns, and the destruction of their larva by the use of kerosene oil.

Means and Methods of Cleaning.—The common methods of house cleaning are wrong in principle, faulty in their execution, and futile in their efforts. The common dry method of cleaning by the housewife and servant is by means of the broom, brush, duster, and feathers. These instruments, instead of cleaning the house, raise the dust, flap around the dirt, disturb quietly lying matter, and disseminate infectious material otherwise harmlessly resting in peace.

It is remarkable that centuries of progress have not helped to evolve a more rational and sanitary method of housecleaning. The common wet method of cleaning is not much more efficacious. The scrubbing of floors, spilling of pails of water upon floors and surfaces, soaking the woodwork, rendering it damp and mouldy, are not ideal methods of cleaning, likely to assist in the elimination of dirt and house insects. The carpet sweeper and dry-rag duster may be included among abominations in house cleaning.

Undoubtedly the best method of cleaning is by means of the vacuum cleaners. Some of these are portable and operated by hand power or by electricity; others are installed in the house as a whole system with tubes and piping to all rooms, and special arrangements which make the exhaustion of dirt and dust a matter of little difficulty. No greater evidence of the enormous amount of dirt found in the carpets and rooms of houses is needed than the barrels and barrels of dirt which these vacuum cleaners collect. The only objection against them is their expense, but with their universal introduction this may become smaller.

The other rational method of cleaning is by going over all the walls of rooms and the objects in the rooms with damp rags, thus removing the dust and dirt; occasionally some mild antiseptic, such as turpentine, carbolic acid, or a weak solution of corrosive sublimate, should be used.

In house cleaning it is of the utmost importance to make the process thorough, regular, and periodic. Houses and rooms must be cleaned daily, weekly, monthly, and a special cleaning must be given every three months at the end of the season.

CHAPTER III.

THE HYGIENE OF FOODS AND FOOD SUPPLY.

FOODS.

"*Food is that which, when taken into the body, builds tissue or yields energy.*" Everything is therefore food which may be used for the purpose of replacing the wear and tear of the cells of the body, or of supplying heat and energy to the body, or of storing up such energy for future use.

The following, while not strictly foods are also included: (1) certain materials, consisting of cellulose or wood fiber, which, though not serving to "build tissue or yield energy" are needed to give bulk to the foods ingested and serve a certain purpose in the physical process of digestion; (2) water; (3) certain ingredients, called vitamins, the functions of which are not yet determined but the necessity of which are clearly manifested.

Sources of Food.—The sources of human food are the animal, vegetable and mineral kingdoms. The flesh of a large number of domestic and wild animals is used as human food when specially prepared and modified. As food are also used a number of cereals, roots, vegetables, fruits and nuts, either in the natural state or specially prepared and modified by art and science.

We also use as food certain minerals found either in the natural state or as ingredients of other food products.

Chemical Composition.—In their final analysis, all foods contain the elements: Carbon, hydrogen, oxygen, nitrogen, sulphur, sodium, potassium, calcium, magnesia, etc.

Most of the foods are derived from the organic world. The inorganic foods are the mineral matter and water. The organic foods are divided into two main groups: Nitrogenous and non-nitrogenous.

Nitrogenous protein	White of eggs, curd or casein of milk, lean meat, gluten of wheat, etc.
Non-nitrogenous protein	Carbohydrates: sugar, starch, etc. Fats: animal, vegetable.

The Relative Use and Value of Each Food Component.—Each of the food components is essential to life. A certain amount, therefore, of each must be used in order to sustain and continue life.

Protein.—The muscles, the blood, the lymph, and other parts of the human body and organs contain a large percentage of protein or albumin matter. There is a constant loss of these protein cells in the body metabolism, and consequently a need to repair and replace this loss. This is accomplished by the ingestion of foods which have a certain percentage of protein in their composition. All animal foods contain a large proportion of proteins, while vegetables, with a few exceptions, contain but a small proportion of protein.

The chemical composition of protein matter depends upon its source. Thus there are different varieties of protein matter, such as the albumins, globulins, albuminoids, nucleo-albumins, peptones, etc.

Carbohydrates and Fats.—The heat and energy of the body use up certain elements, such as oxygen, carbon, and hydrogen, and these must be replaced by food. The carbohydrates and fats supply this need. Fats and carbohydrates are to some extent interchangeable. The principal elements of food which furnish the carbohydrates are the sugars and the starches, which digestive processes convert into sugars. The fats are found in foods in the form of fat and oil.

Mineral Matter.—The body contains a quantity of mineral matter which is found in the form of ashes when the body is burned. The minerals which have been enumerated are found in the body and are also needed as food for the formation of bone and as an aid to digestive processes. It is claimed that the lack of certain inorganic matters, especially acids, is capable of producing the disease called "scurvy" which is found among sailors and others who are deprived of foods containing those acids.

Water.—The human body consists of two-thirds of its weight of water. The body loses water constantly through the lungs, skin, and excretory ducts, The amount of the daily loss of water depends upon many factors, and is estimated at from 2000 to 3000 grams. There is therefore needed a considerable amount of water for daily use, and this is partly furnished by the water which is a component of nearly every food, and partly by the water consumed with, or in addition to, the food.

Vitamins.—Under this term are grouped certain elements of food, the exact chemical composition of which is as yet unknown, but the presence of which ingredients is absolutely needed in foods to preserve the health and life of man. The absence of vitamins is known to have caused certain diseases, such as beriberi, scurvy, and possibly pellagra, as well as other ill-defined conditions of health. These vitamins are important to the well-being of the body. They are found in the skin and coating of grains, in the yolk of eggs, in raw meat, in fresh fruits, vegetables, etc.

Cellulose.—Cellulose is a constituent of vegetables, fruits, grains, etc. It is contained in a large measure in certain vegetables, like lettuce, celery, spinach, asparagus, cabbage, tomatoes, berries, etc. While cellulose is not strictly a food, it is necessary to give bulk to the foods ingested and to aid in the intestinal peristalsis.

Estimates of Food Values.—Foods are necessary for the metabolism of the body. Like all organic substances, foods, when oxidized, burned or metabolized in the body, produce heat. The exact amount of heat produced by a certain food, or a given quantity of a certain food, will differ according to the nature of the food and also according to the amount of water and elements incapable of producing heat which it may contain.

Foods when ingested, digested and assimilated, produce the same amount of heat and energy as when burned outside of the body. Hence this amount of heat may be measured, standardized and serve as the criterion of heat and food values. The definite measure of the heat value of a food is the *calorie.* A *calorie* is the amount of heat required to raise one kilogram of water one degree Centigrade, or the amount of heat required to raise one pound of water four degrees Fahrenheit.

According to Rubner, one gram of protein or carbohydrate gives 4.5 calories while one gram of fat gives 9.3 calories.

According to Langworthy, one pound of protein or carbohydrate gives 1860 calories, while one pound of fat will give 4220 calories.

We have therefore in these standards a means for finding out the caloric value of foods, provided we know what percentage of protein, fat and carbohydrate they contain.

Dietetics and Preparation of Food.—By diet is understood the quantity, quality, and kind of food taken in by the person daily.

There are a great many factors determining the value of the average person's diet. The main factors are as follows:

The person: Age, weight, physical condition, race, condition of rest.

The food: Chemical composition, physical conditions as to form, volume, consistency, percentage of edible and inedible parts, temperature, etc.

General conditions: Climate, temperature.

It is difficult to make hard-and-fast rules for dietetic standards. Human beings adjust themselves easily to different kinds and forms of food, and during health, as a rule, do not suffer much except when they take either too much or too little food, or are fed exclusively on one food or on food which lacks some of the necessary nutrient ingredients.

A prolonged and constant overuse or underuse of certain food element is bound to cause pathological conditions and is the cause of certain diseases of digestion and metabolism.

The form and consistency of food is of much importance, for food must be in such condition as to be readily digested. Many foods must be mechanically ground by the teeth; some are chemically acted upon in the mouth by the processes of mastication. This not only prepares the food for the stomach by softening and dividing it into small particles, but also aids much in the conversion of starches of vegetables and cereals into sugars.

There is still much controversy as to the value of an exclusively vegetarian diet, as well as to the comparative percentage of the protein and carbohydrate elements needed for persons. For the average healthy person a mixed diet of animal and vegetable food is probably the most appropriate, and the amount of the protein matter must be somewhat limited, much depending upon the physical condition and habits of the person.

The cost of food depends also upon very many factors. Often it is not the most costly food that is the most useful or nourishing, as some of the causes of the high cost of food are its rarity, difficulty of obtaining it, the manner of preparation, the place where it is sold, and the matter of taste. For physical subsistence, cereals, vegetables, nuts, fish, and flesh of animals furnish all the necessary nutrient qualities, and some among these are of comparatively low cost, their nutritive value being, however, quite as great, if not greater, than that of the more costly foods.

Raw, Cooked, and Prepared Foods.—Some cereals, a large number of vegetables, most of the fruits, a number of nuts, and some forms of animal foods may be taken in their natural state. The flesh of animals is seldom used raw, although the fat is often so used and in some climates the flesh is also eaten raw.

The process of cooking foods greatly improves the consistency and form of most foods, develops the flavors, increases the digestibility, improves the taste, and generally enhances the value of food for human beings. Much of the increased digestibility and value of the food depends upon the various forms and processes of cooking.

The food may be heated (pasteurized at 160° F. for ten minutes). This process destroys certain pathogenic germs, softens the food, and is valuable for the preparation of milk, for the cooking of soft-boiled eggs, etc.

Boiling, stewing, steaming, baking, roasting, and frying are some of the various modes of subjecting foods to heat. The value of each process depends more or less upon the kind of food and various other conditions.

In *stewing*, the food is cut into small pieces and put in cold water and heated slowly. This is an economic method of preparing certain meats and vegetables.

Boiling is a more rapid process in which the food is put into hot water and kept at a boiling temperature.

Certain foods, especially fruits and cereals, are more tender and digestible when prepared by means of *steaming.* The food is placed in a double pot, the water is boiled in the lower part, and the food in the upper part is subjected to the steam formed by the heat.

Baking and *roasting* are processes by which the food is exposed to the direct radiation of heat in open or enclosed ovens.

Frying is a form of roasting in which the food is placed in a pan and fried in fat.

Boiling and frying somewhat toughen the fibers of the food and render it less digestible than the other processes.

Care, Storage, and Preservation of Food.—All foods when left exposed for some time undergo a process of deterioration and decomposition. This is due to the breaking up of organic tissue into its simple components, and finally into its primary elements, the decomposition being due to the action of microörganisms. The majority of the microörganisms which cause the breaking up of the tissue of the foodstuffs are harmless. The deterioration of food is also due to various moulds, yeasts, and other vegetable and animal germs which are found almost everywhere. In order to prevent the deterioration of foodstuffs, the action of the destroying germs must be inhibited or stopped.

Foods that are overripe or underripe, that have fungi, parasites, or worms in them, or that lack protective coverings, usually undergo more rapid decomposition. Certain foods when in a process of decomposition develop chemical poisons which cause serious disturbances in those eating the foods. These are sometimes called ptomain poisoning.

In order to care, store, and preserve foods in the house, certain conditions are necessary: (1) A sound condition of the food; (2) dry air; moisture is absolutely necessary to decomposition, and its presence favors the growth and development of low organic and bacterial life; absence of moisture is a preventive against decomposition; (3) absence of flies and insects: certain insects injure the food and also bring to it germs which aid in decomposition; all foods must be examined and covered to prevent the access of these insects. It is best to have all foods covered or wrapped in protective coverings so as to prevent their injury from the outside agents.

Temperature.—A low temperature, even below the freezing-point, does not kill bacteria, but it stops and inhibits their further growth. At a temperature of 40° to 45° F. the growth of germs is greatly retarded, and this is the best temperature at which to keep and store foods.

Food in houses is stored in separate rooms, pantries, cellars, or ice-chests. Wherever it is stored care must be taken to have an equable temperature, below 45° F., and as far as possible each food should be separated and kept apart from other foods.

Drying.—The method of drying foods in order to preserve them is efficient in proportion to the thoroughness of the process. Drying is adaptable to meats, cereals, seeds, and some fruits. The drying is done either in the sun or on fires. Some foodstuffs may be preserved for a long time.

Salting and Pickling.—Salting and pickling are partly chemical and partly physical methods of food preservation. Salt prevents decomposition by reason of its antiseptic qualities and by its absorption of moisture. This method is applicable to meats and fish. Fish are also preserved in brine or salt solution. Pickling is the keeping of food, such as fish, certain vegetables, and fruits, in vinegar. These processes harden to some extent the fibers and diminish the digestive qualities of the food.

Smoking.—The method of food preservation by smoking is really a combination of several methods, drying, salting, and chemical. It is said that the creosote in the wood smoke to which the food is exposed serves as an antiseptic. Certain meats and fish are preserved by smoking. This hardens the fibers and makes them less digestible.

High Temperature.—Foods may be preserved by subjecting them to high temperature. This destroys all microörganisms and prevents the decomposition of the food. The heating of the food to 140° F. from ten to fifteen minutes is called *pasteurization*. Heating to the boiling-point and subjecting the food to this heat for one-half hour or longer is called *sterilization*. It effectively destroys all microörganisms, even the spore-bearing bacteria.

Canning.—Many foods may be preserved for indefinite periods of time by sterilization with heat and by subsequent storage in hermetically closed tin or glass receptacles. Many kinds of meats, fish, fruits, and vegetables are at present preserved by the process of canning. The food is cut in appropriate forms and placed in tin cans of various sizes. It is then covered with hot water and boiled. The cans are covered except for a very small opening at their tops, and subjected to a high degree of heat in steam boilers for the period of an hour or longer. When taken out the opening is sealed with solder, and after the cans have again been subjected to heat, they are taken out, cooled, labelled, and stored. In this condition they may be kept for very long periods.

If the food in the cans is not properly sterilized and if decomposition subsequently sets in, the carbonic acid gas developed in the cans causes a bloating or bulging out of the top or bottom of the cans, which indicates that the food has undergone some decomposition. Such cans should be rejected.

Adulteration.—By adulteration is meant the "altering" of the normal composition and consistency of the food. Food adulteration is accomplished in various ways: (1) By mixing with the food some foreign substance to reduce, lower, or injure its quality and strength; (2) by the entire or partial substitution of an inferior substance; (3) by the entire extraction of a portion of valuable substance from it; (4) by the sale of imitations leading the consumer to purchase articles he never intended to buy; (5) by the sale of food, in part or wholly, of a diseased, decayed, or decomposed substance; (6) by coloring, coating, polishing, or powdering the food, thus concealing its poor quality, or making it look better than it is; (7) by introducing into the food a poisonous constituent, or any ingredient likely to be harmful to the consumer.

Adulteration may be harmful, fraudulent, or accidental. Harmful adulteration includes all those which are either directly harmful by the addition of injurious substances, by the decomposed or unwholesome state of a part or the whole of the food, or by the dilution or extraction of some nutrient part of the food, thus rendering it less nutritious. Under fradulent adulterations are classed all those which do not directly or indirectly harm the consumer, except in deceiving him and making him pay more than he would normally have paid.

There is much adulteration of foods in commerce and trade. The Federal Food and Drugs Act makes stringent provisions against adulteration and misbranding, and much has been done by the Government to insure the purity of foods and the honesty of their adulteration. Much more, however, remains to be done. The methods of adulteration of foods are many and change from time to time.

MEAT AND MEAT SUPPLY.

Hygiene of Meat Foods.—The hygiene of meat foods may be considered according to the following subdivisions:

Dangers to Health.—Infection by entozoa, bacteria, toxins, and ptomains.

Etiology.—Diseases of the animals, conditions of the animals, postmortem changes, postmortem infection. adulteration.

Prophylaxis.—Hygiene of the food animals: meat inspection, antemortem and postmortem; hygiene of place and persons; preservation, sanitary supervision of manufacture, etc.

Dangers to Health.—The dangers to health from the ingestion of flesh foods are due to infection by entozoa, infections by bacteria, and to the action of toxins and ptomains.

Parasitic Diseases Due to Meat.—These are due to (1) infection by tapeworms, (2) infection by trichina, (3) infection by echinococci.

Tapeworms.—The two principal species of tapeworm found in man which are due to meat infection are the *Tœnia saginata* and the *Tœnia solium;* the former is due to infection by "measly" beef, the latter by "measly" pork.

The *Cysticercus cellulosœ* is the larval form of the *Tœnia solium.* It appears in hogs in the shape of minute bladder worms, encased in little cysts which are found in the intestines, muscular fibeıs, brain, liver, and other parts, and especially under the tongue, where it may readily be recognized. The cysticercus is derived from the segment and egg of the *Tœnia solium,* which are passed from the human intestine ingested by the hog, and on reingestion by man develop again into tenia.

The *Cysticercus bovis* is the larval form of the *Tœnia saginata* of man, and is found in the intermuscular fibers and connective tissue of cattle.

Trichina.—The *Trichina spiralis* is a parasite found mostly in the muscular fibers of pork in the form if minute spiral-form worms, which are encapsulated, but may be recognized with the naked eye as white specks. The ingestion of pork infected by trichina causes in man the acute disease called "trichinosis," which is due to the presence of the trichina in the muscular fibers. Its symptoms resemble those of typhoid fever. The disease is often fatal.

Echinococcus.—Echinococcus sometimes infect sheep and, rarely, cattle. The infected meat causes in man the hydatid diseases. Originally the infection comes from *Tænia echinococcus* found in dogs.

Meat Infection by Bacteria.—Pathogenic bacteria may be found in the flesh of animals, and such infected flesh on consumption is capable of producing disease. The pathogenic bacteria may originate in the diseased condition of the live animals suffering from the infectious diseases, or they may gain entrance into the meat of healthy animals through infection by contact, etc., after killing.

The diseases of animals infectious to man which are caused by pathogenic bacteria and which, it is claimed, may be transmitted through their meat to man, are the following: Tuberculosis, pleuropneumonia, foot-and-mouth disease, cattle plague, anthrax, glanders, malignant edema, erysipelas, actinomycosis, typhoid fever, cholera, pyemia, septicemia, tetanus, sheep-pox, Texas fever, etc.

Toxins and Ptomains.—Certain meat causes, on ingestion, toxic symptoms. These symptoms are due to toxic substances in the meat or to bacterial products of decomposition called "ptomains." The symptoms resemble those of severe gastro-intestinal inflammation, and may be fatal. The *Bacillus botulinus* has been regarded as the cause of some of the toxic influences of certain meats.

The virulence of the intoxication by meat differs according to the condition of meat, the manner of preparation, the quantity ingested, and the individual idiosyncrasies of the victim. Intoxication is most frequently caused by the eating of "prepared meats," such as chopped meats, sausages, canned, "potted," and "deviled" meats, etc.

Causes of the Unfitness of Meat for Food.—These may be: (1) The diseases of animals; (2) the unfit condition of living animals; (3) postmortem changes; (4) infection of the meat by persons or by places of manufacture, sale, etc.; (5) adulteration.

Diseases of Food Animals.—The diseases of food animals, which render their meat totally or partly unfit for food, have already been enumerated.

Condition of Food Animals.—The conditions of the food animals, which may render their meat unfit for food, are the following:

1. The death of the animals from age, disease, or accident.

2. Moribund conditions from injury, drugs, overwork, fright, overdriving, etc.

3. Immaturity: unborn calves and lambs and animals in the first few weeks of life, are unfit.

4. Artificial conditions and treatment of the carcasses by blowing up (blown veal), coloring, etc.

Postmortem Changes.—The temperature, moisture, and substances of the slaughtered carcass make a favorable medium for the development of microorganisms which swarm in the meat or may gain access later. The resulting decomposition and organic changes necessarily cause the meat to deteriorate and render it unfit for food unless bacterial action is inhibited by placing the meat in a condition rendering the development of bacteria and putrefaction unfavorable. The rapidity of deterioration depends on the condition of the animal from which the meat was obtained, the cleanliness of the process of preparation, and the place in which it is kept.

Infection by Persons and Places.—In addition to the foregoing sources of deterioration, meat may be directly infected with pathogenic and other bacteria by the persons who handle it and take part in slaughtering, skinning, dressing, cutting, manufacturing, and packing.

Food may also become infected in the various places through which the meat must pass in the process of manufacture.

Adulteration of Meat.—Meat adulterations may consist in:

1. The addition of foreign substances reducing, lowering, or injuring the quality of the food.

2. Partial or entire substitution of an inferior substance.

3. Extraction of some of the valuable substance from the meat.

4. Coloring, coating, or otherwise changing the appearance of the food, concealing its poor quality or making it appear better than it is.

Characteristics of Good Meat.—Good meat is uniform in color, neither too red nor too pale, firm and elastic to the touch, moist but not wet; it does not pit nor crackle on pressure, and has a marbled appearance. It is free from unpleasant odor, its juices redden litmus paper slightly. The fat is firm and does not run. Beef is bright red, more marbled than any other meat. Veal is pale and less firm to the touch. Mutton is dull red, firm, and its fat white or yellowish. Horse meat is coarse in texture, dark in color, without layers of fat in the muscles; the fat is yellowish and runs down in drops when the carcass is hung up, and has a peculiar sweetish odor and taste.

Preservation of Meat.—Postmortem putrefactive changes due to the development of bacteria can be prevented: (1) By rigid asepsis and the cleanliness of those who handle the meat and by careful attention to sanitation in the places in which meat products are prepared. This prevents the bacteria from gaining access to the meat. (2) By the storage of meat under conditions that are unfavorable to the life and development of bacteria. These are cold, dryness, and condimental or partly chemical preservations. (3) By destruction of all the bacteria, *i. e.*, by sterilization of the meat by heat.

Cold Storage.—Cold storage of meat does not kill bacteria, but inhibits their growth, and keeping meat in cold storage or freezing may preserve it for a long time. The common opinion that meat may be kept in cold storage indefinitely without injury is wrong, for meat certainly deteriorates if it is kept at a low temperature for more than two or three months. On thawing, frozen meats deteriorate very rapidly, and they have been known to produce toxic symptoms on ingestion. As an auxiliary means of preservation for not too prolonged periods cold is a valuable preservative.

Drying.—Drying of meat is an old method of preserving it, and may be a valuable means of preserving the meat fibers; but they should be rendered very dry, or in the form of powders. Drying may be accomplished in the sun, and is very slow, or it may be done artificially. Its usefulness is necessarily limited.

Condimental Preservation.—Condimental preservation of meat consists in preserving it by the aid of salt, sugar, vinegar, and other condiments, either in dry form (with salt) or by the wet process (pickling in vinegar, etc.). These condiments do not kill the bacteria, but they effectively stop putrefaction and may preserve certain meats for long periods.

Smoking.—Smoking meat renders it not only comparatively dry but also impregnates it with the creosote of the smoke, which serves as a valuable means of preservation of certain kinds of meat.

None of the above methods of preservation destroy parasitic ova, or all the pathogenic germs which may be in the meat, and all except cold render the meat less digestible, and somewhat alter its texture, appearance, and taste.

Chemical Preservatives.—The use of chemical preservatives, such as borax, boracic acid, sulphite of soda, and others is very reprehensible, and is justly prohibited by federal and municipal sanitary legislation.

The objections against chemical preservatives of any food may be summed up as follows:

1. All chemicals used for preservation are more or less toxic, and their ingestion injurious to health, especailly if habitually used.

2. By the use of chemical artificial preservatives

inferior meats and products and meat which is partly decomposed may be so disguised as to be sold as fresh and unspoiled products.

Heat.—Heat preservation of meat is the only effective and absolutely reliable method of preservation, because it kills and destroys all entozoa and pathogenic germs, and thus renders the product sterile and absolutely safe.

For domestic use the sterilization of meat is accomplished by roasting, baking, or boiling for from fifteen minutes to an hour. *For commercial purposes the process of meat preservation* should include (1) destruction of all germs by heat, and (2) enclosure of the product in hermetically closed sterile vessels in which further infection is prevented, thus permitting the food product to be preserved for indefinite periods. This process of meat preservation consists of "canning," and is accomplished in the following manner: (1) By selection of appropriate meat; (2) cutting it into appropriate pieces; (3) parboiling or exposing the meat in hot water under the boiling-point for ten to twenty minutes in order to shrink it and lessen its bulk; (4) the parboiled meat is placed in cans or tins filled with salted soup or liquid and the cover is soldered on, except for a small aperture for the escape of air; (5) the cans are then placed in boilers or steamers and subjected to high heat for an hour or two; (6) the openings left in the cover of the can are closed and the cans are again subjected to a steam bath for an hour or more, according to the character of the product.

Sanitary Supervision, Prevention of Adulteration of Meat.—The strict sanitary supervision of all the various processes through which meat passes from the initial to the final product is absolutely necessary in order to render the food supply free from dangerous contamination and infections. Adulteration by substitution, palming off inferior products for superior ones, and adulteration with foreign ingredients, as well as by artificial preservation by means of chemicals, may be prevented only by a rigid, thorough, scientific, and prompt municipal and federal inspection by qualified and competent medical officers.

Poultry and Game.—The flesh of all domestic fowls, such as chicken, turkey, geese, duck, and of some wild fowls, is used for human food.

Vacher[1] gives the following characteristics of healthy poultry and poultry meats: "Healthy poultry are active, bright, dry in the eyes and nostrils; the feathers are glossy and elastic, and the combs and wattles are firm and brilliant red. Age is indicated by duskiness of comb and gills, dulness, fading, and brittleness of feathers, raggedness of feet and size of claws. Good poultry should be firm to the touch, pink or yellowish in color, fairly plump, should have a strong skin, and a fresh, not disagreeable odor. Stale poultry loses firmness, becomes bluish in color, green over the crop and abdomen; the skin readily breaks, and the bird has a disagreeable odor."

"Drawn" or "undrawn" are terms used to indicate the removal or presence of the internal organs of poultry offered for sale. Undrawn poultry decomposes sooner on account of intestinal putrefaction. Cold-storage undrawn poultry may become dangerous

[1] Food Inspector's Handbook.

to health by its deterioration. As poultry can be obtained at all times there is no good economic reason why it should be placed in cold storage for long periods, and the practice is reprehensible. The custom of keeping poultry or game for a certain time until it is "ripe," or "gamey," and partly decomposed, is dangerous to health.

Forced feeding does not seem to produce any pathological conditions in poultry, and even the "fatty liver" of forcibly confined and fed geese, in the much-prized delicacy "pâté de foie gras" does not seem to affect the gourmand injuriously. Live poultry is subject to many and various diseases which render the meat unfit for use, and the necessity of rigid antemortem inspection is apparent in this as well as in other meats.

Fish Foods.—A large variety of sea and fresh-water fish are used for food. Fish are allowed to die by being deprived of oxygen. Fish should be used in season, should be fresh, firm, and elastic to the touch. Fresh fish may be recognized by the rigidity due to rigor mortis, the freshness and red color of the gills, the moist, clear eye, and not disagreeable odor.

Frozen fish is not palatable, and decomposes very rapidly on thawing. Many cases of poisoning, including ptomain poisoning from eating stale fish, are on record.

The eating of certain shell-fish, crabs, lobsters, and oysters is at times fraught with danger to health, and many cases of wholesale poisonings have been reported. Oysters sometimes are purveyers of typhoid fever, when they are grown near large towns in waters that are much contaminated by sewage containing typhoid germs. The danger from oysters is the greater in that they are very often eaten raw.

Fish are preserved by smoking, drying, salting, pickling, and also by canning.

The sanitation of the establishments where fish are prepared for canning should be the same as that for the manufacture of meat products.

MILK AND DAIRY PRODUCTS.

Importance of Milk as a Food.—Of all the various foods used by human beings milk is the most important. Milk contains all the elements of food necessary for the nutrition of man, and it contains these elements in a right proportion. Milk is the only food of millions of infants and children deprived of the breast; it is the principal food of the sick, of invalids and convalescents, and it is a part of the food of all people at all times.

The great importance of milk and milk products as a food and the magnitude of the milk industry make it of paramount importance that they should reach the consumer in as clean and as pure a state as possible. This, however, is almost impossible for the following reasons: (1) Distance, (2) time, (3) the nature of the product, and (4) contamination.

Distance.—In the milk supply of cities the distance of the producers from the consumers is necessarily great. New York City obtains its milk supply from about 44,000 farms located in six States and within a radius of 400 miles from the city.

Time.—The city consumer of milk hardly ever gets it less than twenty-four hours old, and often thirty-six and forty-eight hours elapse between milking and consumption.

Nature of Product.—Milk, being an opaque animal secretion voided at a temperature of the body, is easily contaminated with all kinds of impurities difficult of detection.

Sources of Contamination.—These are very numerous. They may be the cow, the food and water she drinks, the stable, barnyard and surrounding of the cow, the pails, cans, and various utensils used by the farmer, milkers, and handlers of the milk, and a great many other things.

Character of Impurities.—The impurities which are found in milk may be divided under two large groups: Dirt and bacteria.

Dirt.—By dirt is meant everything found in milk which is foreign to its composition and is not milk, which "is matter out of place." The dirt may be mineral, vegetable, or animal. The mineral dirt consists mostly of dust, sand, clay and earthy particles; also of certain preservative salts used for increasing the keeping qualities of milk. Vegetable dirt is composed chiefly of particles of hay, straw, grain, seeds, flowers, etc. The animal dirt, which is abundantly found in milk, is mostly hair, feathers, manure, insects, flies, ova of parasites, etc.

The amount of dirt found in milk is in direct ratio to the care taken in the production of milk. It is often very large. Most of the dirt may readily be seen at the bottom of vessels after milk has been left standing for some time; it may also be readily obtained by the action of the centrifuge.

Bacteria in Milk.—The most important impurities found in milk are bacteria.

Bacteria are minute vegetable microörganisms, invisible to the naked eye, but discernible under the microscope, and are found everywhere. Bacteria are of various shapes, some round, others spiral, rod-shape, etc., and are found clinging to soil, dust, dirt, rubbish, excreta, discharges, etc. They develop very rapidly under favorable conditions, millions of them growing out of one colony.

The importance of bacterial life lies in the fact that to it solely is due the process of putrefaction and decomposition, and the disintegration of all organic matter.

Besides their putrefactive action bacteria may also play a more important role in the causation and transmission of disease.

Within the last several decades it had been definitely demonstrated that many diseases, the true causes of which were hitherto unknown, were directly due to the action of certain bacteria which upon gaining entrance into the human body cause certain pathological lesions resulting in certain groups of symptoms which we call by names of various diseases. These diseases are usually called "infectious," because they are caused by bacteria and may be transmitted from one person to another.

A large number of infectious diseases are known to be transmitted from one person to another by means of food and especially milk.

Disease Bacteria in Milk.—A large number and many varieties of disease bacteria may and often are found in milk.

The sources of the disease germs are the cows, their surroundings, their food and drink, the persons handling the milk, and the utensils in which it is kept, as well as the air with which it may come in contact.

Besides the disease germs themselves milk may be contaminated by the common germs of putrefaction. These do not cause disease by themselves, but they may produce toxic elements in the milk which may harm the consumers and cause certain gastro-intestinal disturbances and "ptomain" poisoning, often with fatal results.

The infective bacteria which may be transmitted by milk are those of the following diseases: Diphtheria, scarlet fever, measles, tuberculosis, cholera, typhoid fever, dysentery, cholera infantum. A number of other infectious diseases have also been transmitted by milk, as has been demonstrated at various times.

Milk and Infants' Diseases and Infant Mortality.—The prevalence of gastro-intestinal diseases among infants and children, especially during the summer months, is well known. Out of a total of 105,553 deaths of infants in the United States during 1905 not less than 39,399 were due to gastro-intestinal diseases.

The difference in death-rate between breast-fed children and those fed on cows' milk in the New York Infant Asylum in 1902 was very great: 7.47 per cent. in the former to 63.14 per cent. for the latter. The record of Rochester, N. Y., where Dr. Goler inaugurated a vigorous campaign on behalf of clean milk for children, proves conclusively how a supply of pure milk will reduce not only the infant mortality during the summer months, but also the general death-rate throughout the year.

In New York City the death-rate of children under five years was reduced from 96.2 per 1000 during the whole year and from 136.4 during the three summer months in 1901 to 55 per 1000 during the whole year and 62.7 during the summer months in 1906. This reduction is undoubtedly largely due to the cleaner milk which is at present supplied to the city and especially to the use of the Straus pasteurized milk among the poor classes of the city.

Milk and Diphtheria, Scarlet Fever and Measles.—It is not difficult to understand how milk may be readily contaminated by the germs of these dreaded children's diseases. The farmer's children, or the children or employees of the milk dealers and sellers may suffer from one of these diseases, and by their proximity to the milk, during acts of coughing, spitting, sneezing, or by the scaling of the skin, may contaminate the open cans of milk with the infective germ and thus transmit the disease to other children and people. A large number of scarlet fever and diphtheria epidemics have been directly traced to infected milk.

Milk and Typhoid, Cholera and Dysentery.—The infective germs of the various diarrheal diseases, like typhoid, cholera asiatica, and cholera infantum, as well as of dysentery, are found in the discharges from the bowels of infected persons. These discharges may cling the the hand, clothes, etc., of those who handle milk, and thus gain access to the milk in which these infective germs find a very favorable medium and are capable of developing and increasing in very large numbers. The most frequent way in which the germs of these diseases gain access to the milk is through water. The discharges of infected patients are often deposited upon the exposed ground, or in shallow privy vaults, cesspools, etc., from which they are washed off, seep through the ground, and gain access to the rivers, lakes, ponds, or wells, which serve as sources of water supply on farms.

The typhoid bacillus has been demonstrated in milk, and its vitality is so great that it retains its life for long periods. Hess reports finding typhoid germs in sterilized milk after four months' time.

According to Whipple (quoted by Ward), "it has been estimated that in the United States at the present time about 40 per cent. of the typhoid fever in cities is caused by water; 25 per cent. by milk."

Water infected with typhoid fever germs may also be used as a washing fluid for milk utensils, or it may at times be used as an adulterant.

Milk and Tuberculosis.—Tuberculosis may be transmitted through milk because the tubercle bacilli which are the cause of the disease may be and are often found in milk. Hess found that 16 per cent. of the New York City milk supply contained tubercle bacilli, and according to the investigation of others the presence of the germs causing tuberculosis has been clearly demonstrated so as to be beyond dispute.

Where do the tubercle germs which are found in milk come from? There is no doubt that some of these germs may come from accidental contamination from the outside. It is easy to see how persons who are afflicted with the disease may, while handling the milk, infect it with tubercle bacilli by coughing, spitting, sneezing; or the germs may be found in the dried dust floating around dairies, or on the hands and clothes, etc., of the persons handling the milk.

There are also strong reasons for believing that a large or a considerable number of the tubercle germs found in milk are derived from the cow herself. Unquestionably a very large percentage of milch cows suffer from tuberculosis. According to many observers the average percentage reaches at least 25 per cent. This means that one cow in every four is affected. The disease is scattered over the entire country and there is hardly a herd that is completely free from its ravages.

The question whether a tuberculous cow gives milk containing tubercle germs has been decided affirmatively, at least insofar as it is now definitely known that cows suffering from advanced tuberculosis which involves the udder yield tuberculous milk.

COWS' MILK.

Definition.—Milk is the lacteal secretion obtained by the complete milking of one or more healthy cows.

Composition.—Milk consists of water in which certain solids are disolved or suspended. The relative proportion of the solids to the water varies from

11 to 14 per cent., to 86 to 89 per cent., with an average composition of 13 per cent. solids and 87 per cent. water.

SOLIDS.—The *milk solids* consist of sugar, fat, proteids, and minerals. Milk also contains a certain amount of ferment, gas, and bacteria.

Milk-sugar (Lactose).—Lactose is a sugar peculiar to milk, found in milk only, and differing somewhat from sugrose, dextrose, and other sugars. Milk-sugar is less sweet, less soluble, less subject to acid fermentation, has a specific gravity of 1.53, is soluble in 6 parts of cold and 2.5 parts of boiling water; undergoes lactic acid fermentation readily, but alcoholic with difficulty (Blyth). The average percentage of milk-sugar in milk is about 5, varying but slightly from this.

Milk-fat.—Milk-fat consists of the glycerides of various fatty acids, volatile and non-volatile. It is found in the milk in the form of an emulsion consisting of very numerous minute fatty globules held in suspension in the whole milk.

The milk-fat is the most variable part of the milk constituents. Its proportion varies between 2 and 6 per cent., with an average of 4 per cent.

Proteids and Albuminoids.—The proteid matters in milk consist of about 80 per cent. of casein and 20 per cent. of other albumins, such as lacto-albumins, protein, nuclein, etc.

The casein is the principal and most valuable proteid matter. Casein is coagulated by acids, by gastric juice, by rennet, and by a variety of other substances; it is not precipitated or coagulated by heat which does coagulate the lacto-albumins. The proportion of proteid matter in milk is less variable than that of fat. Its average is 3.25 per cent.

Mineral Matter.—Milk contains various minerals in minute quantities. Milk-ash shows the presence of potash, soda, lime, magnesia, chlorine, iron, certain acids, etc. The percentage of mineral matter in milk averages 0.75.

Composition of Average Milk.

Water . . .	87 per cent.		
Solids . . .	13 per cent.	Sugar . . .	5.00 per cent.
		Fat	4.00 per cent.
		Proteid . . .	3.25 per cent.
		Mineral . .	0.75 per cent.
			13.00 per cent.

Ferments and Gases in Milk.—Milk contains a number of ferments or enzymes (diatose, galactose, etc.) which are peculiar to every species of animals and have some function in the digestion and nutritive qualities of the milk.

Milk when fresh also contains some gases, such as oxygen and carbon dioxide, due to the air it contains. Later the pressure of carbon dioxide may be due to fermentation.

Appearance, Color, and Reaction.—Normal milk has a white or slightly yellowish color; it is opaque, has a a pleasant characteristic odor, and a sweetish taste.

The reaction of milk is "amphoteric," *i. e.*, slightly acid to litmus and alkaline to turmeric. The reaction becomes more acid with the advance of lactic acid fermentation; when milk becomes decomposed it develops ammonia and becomes alkaline in reaction.

Specific Gravity.—The weight and density of milk are greater than of water, inasmuch as most of the milk solids are of a relatively greater weight and density than water.

The heavier and denser solids are the milk-sugar, the proteid matter, and the mineral matter. Milk-sugar, specific gravity 1.55, proteids 1.20 (Rubner). The only ingredient of milk which is lighter and less dense than water is the milk-fat (0.92).

If a liter of water at 60° F. (15° C.) weighs 1000 grams, a liter of milk at the same temperature will weigh from 1028 to 1032. The specific gravity of average milk is usually 1.029, with variations from 1.028 to 1.032.

Milk without fat (skim milk) will have a much greater specific gravity, for the lighter part is withdrawn. The specific gravity of skim milk ranges from 1.035 to 1.040, according to the more or less thorough removal of the fat.

The specific gravity of milk is increased by low temperature, by the addition of solids, and by the substraction of fat. It is decreased by high temperature, by the addition of water, and by the addition of fat.

Variations.—Not only the quantity but also the quality and the relative amounts of the various milk ingredients vary greatly. Some of the factors on which the variation depends are the breed of the cow, age, kind, health, condition, care, food, drink, housing, treatment, climate, time of year, time of day, period of lactation, season, weather, and many others too numerous to mention. Most of the variations produced by these factors are normal and are expressed in the relative quantity of milk produced, or the relative proportion of its various ingredients. Among the most important variations in milk are those which are found in colostrum, fore-milk, and the strippings.

Colostrum.—For a certain period before and for several days after parturition the milk secreted by the cow differs materially in composition from normal milk. While most cows "dry up" or cease to give milk in the last months or weeks of pregnancy there are some which continue to produce milk until the last days of pregnancy. During the ten days or two weeks before calving and from three to five or six days after the milk derived from cows is called "colostrum," or commonly "bee stings."

Colostrum differs in composition from normal milk in that it contains a relatively smaller percentage of water (about 75 per cent.), relatively less milk-sugar and milk-fat, and relatively more protein matter, not in the form of casein but of lacto-albumin. To the latter it owes its property of coagulation by slight heat, a distinctive characteristic of colostrum. Colostrum also contains a considerable number of blood corpuscles and of the so-called "colostrum corpuscles."

The color of colostrum is distinctly yellowish and reddish, the taste peculiarly sweetish, and the odor specific. The ingestion of colostrum, especially when heated, is relished by a number of persons, although it has been known to cause gastric disturbances. The mixing of colostrum with the rest of the milk, or its sale, is forbidden by most municipalities.

Fore-milk and Strippings.—There is a considerable difference in the relative amount of milk-fat in the few streams of milk derived at the beginning of milking from that of the few streams of milk derived at the end of the milking. The first milk, called fore-milk, contains sometimes less than 1 per cent. of fat, while the last, called strippings, contains sometimes over 5 per cent.

Abnormal Milk.—Milk is sometimes abnormal in color, composition, etc., and the sale of such milk is usually forbidden.

Milk may be abnormal in color, distinctly red, blue, yellow, violet, etc. These abnormal colors of the milk are due to contamination with specific bacteria, which produce the changes in color.

The odor and taste of milk may also be abnormal. Thus milk sometimes is distinctly bitter or has the taste of garlic, onions, turnips, cabbage, etc.; it may bear some of the characteristic odors of strong vegetables, etc. Milk may also have a distinctly fermentative and "swilly" taste. Most of these deviations from the normal are due to the food ingested by the cow. The bitter taste may be due to bacterial action.

Milk may be abnormal in its consistency and become "slimy," "ropy," and viscous. In this condition it will not churn, nor will the cream separate, but otherwise it does not seem to be very harmful. The condition is due to the action of certain bacteria. Ropy milk is said to be a favorite article of food in Norway and elsewhere, and may be artificially produced by immersing the stem of "butterwort" in milk (Blyth).

MILK PRODUCTS.

A consideration of milk production and inspection is incomplete without reference to the most important products which are a part of the milk industry. The milk products are the following: Cream, skim milk, butter, buttermilk, cheese, whey, condensed and evaporated milk, milk powders, koumiss, kefir, etc.

Cream.—Cream is the fatty portion of milk. It has the same composition as milk except that the percentage of fat is very much larger. The percentage of cream in milk may vary from 6 to 50 or 60, and depends upon the process of obtaining it from the milk. The average amount of butter-fat in cream is 20 per cent.; the United States standard is 18 per cent.

Production of Cream.—Cream is found in milk, in suspension, in minute globules of varying size. It is separated from milk by two processes: the gravity method and by aid of the centrifuge.

Separation by aid of gravity is the oldest known process of gaining cream. It is based upon the fact that the suspended fat globules are of a lesser specific gravity than milk and rise to the surface when the whole fluid is left at rest. The common method is to pour the newly drawn milk into vessels and let them stand for a period of twenty-four to thirty-six hours. The cream rises to the surface and appears as a yellowish layer, and may be accordingly removed from the milk. Gravity methods may be divided into two, the shallow-pan and the deep-vessel setting systems.

Cream is also separated by centrifugal force in special "separators," which remove all fat except 0.1 per cent., which is left in the skim milk. This is an effective process of separation.

Skim Milk.—Skim milk is milk from which all or part of the cream has been removed. The amount of fat remaining in skim milk depends upon the methods of separation and the thoroughness by which it is done; it may vary from less than 0.1 per cent. to more than 1 per cent. Skim milk has a white and somewhat bluish color, a high specific gravity varying from 1.035 to 1.040. Because of the proteid and casein it contains, skim milk is a highly nutritious and valuable food. The sale of skim milk is prohibited in many cities, not because of any harm that it may do, but mainly on account of the ease with which it is substituted for a whole milk and the difficulty of detecting the adulteration. The casein may be separated from the skim milk and used for commercial purposes, or it is used for the extraction of its milk-sugar. Certain forms of cheese are largely made of skim milk.

Blended Milk.—This term is applied to a modified milk in which one or more of the components of milk is increased or diminished so as to furnish a modified milk with definite desired stated percentages of certain of the milk components. It is largely used for infant foods, and manufactured according to formulæ prescribed by physicians.

Milk Products.—These are used chiefly as infant foods and are prepared by complete slow evaporation of the water of the milk. As a rule the powders are mixed with some sugar and cereal products.

Condensed Milk.—Condensed milk is a milk from which a large part of the water has been extracted by slow evaporation. It is a very important article of commerce. Most of the condensed milk sold contains about 70 to 72 per cent. of water with 28 to 30 per cent. of milk solids, to which cane-sugar is added to increase the keeping qualities. Some thickeners may also be used to give the condensed milk more "body." The condensed milk is sterilized and sold in hermetically sealed tin cans. When mixed with water it has a sweet, cooked taste.

Butter.—Butter is the milk-fat of the milk gathered into a mass and separated from the milk or cream by the process of churning. Besides the milk-fat which it contains in the proportion of 80 or more per cent., butter also contains water and minute quantities of the other ingredients of milk.

Butter is commonly made of cream which is for this purpose ripened or made to undergo a process of lactic acid fermentation which is supposed to give the butter its valued "flavor." A "starter" made of buttermilk or sour cream is used to produce the "ripening."

Butter is produced by churning or agitating the cream with paddles or spoons, in vessels, tubs, or barrels. These may be revolved by hand or machine power. The particles of fat adhere together and form distinct grains which are worked over, the buttermilk is removed by several washings of water, and the whole turned into a mass by working and pressing together. The process of butter-making requires attention to temperature and other factors, upon which the flavor and quality of the butter depend. Some salt is added to the butter.

Buttermilk.—Buttermilk is the residue left after butter is made from milk or cream. It contains all the ingredients of milk except fat. It contains millions of lactic acid germs, and is a valuable food for man and animals.

Cheese.—Cheese is "the solid and ripened product made by coagulating the casein in the milk by means of acids or rennet."

Cheese is made of whole milk which has undergone some lactic acid fermentation. It is then coagulated or rendered into two parts: one, an insoluble semi-solid composition consisting of the casein and fat, and the other of water (92 per cent.), of nearly all the sugar, of the albumin and the mineral matter. The insoluble part is then pressed out of the water and worked over by pressing and cutting, as well as by the addition of certain ferments, until the desired flavor and texture of the finished product is obtained. Cheese may be made of whole milk, of skim milk, and of milk to which cream has been added. The "rennet" which is added and used for the coagulation of the milk is an extract made from the fourth or digestive stomach of a young calf fed on milk.

There are many varieties and forms of cheese, depending upon the kinds of milk, temperature of fermentation, degree of acidity, manner of coagulation, kind of rennet, process of ripening, the specific "ripening" bacteria used, etc.

The liquid portion which is left after the insoluble part has been removed in the process of cheese-making is called whey. It consists mostly of water, but contains small quantities of albuminous matter and the sugar and most of the mineral matter of the milk. Whey is used for the extraction of milk-sugar, and is also a valuable food for domestic animals.

The casein of the milk which is extracted from skim milk is also used for various purposes in the commercial manufacture of sizing for paper, etc.

Standards.—The relative composition of milk and some of its products given above are only the average composition, found after an examination of a great number of samples of milk, etc., with large variations in the relative composition. In order, however, to guard the welfare of the public and prevent substitution, adulteration, and selling inferior grades of products, municipalities, States, and the federal government have instituted certain *minima* of compositions or *standards* below which milk and its products must not go and must not be sold to the public.

	Solids. Per cent.	Fat. Per cent.	Solids not fat. Per cent.	Water. Per cent.
Milk	11.75	3.25	8.5	88.25
Skim milk . .	9.25			
Condensed milk .	28.00	7.00	...	72.00
Cream	..	18.00		
Butter	..	82.50		
Cheese . . .	..	50.00		

The New York State standard for milk was 12 per cent. solids and 88 per cent. water until 1910, when it was lowered by act of Legislature to 11.5 per cent. solids and 88.5 per cent. water.

The New York City standard for milk is 12 per cent. solids, of which 3 per cent. must be milk-fat.

Other States and cities have slight variations from these standards.

"Standards are based upon data representing materials produced under American conditions and are fixed as such that a departure from above or below the minimum limit they prescribe is evidence that such articles are of inferior quality. The limits fixed as standards are not necessarily the extremes authentically recorded for the articles in question, such extremes being due to abnormal conditions as a rule." (Wiley.)

Official Definitions.—The following are the official definitions of milk and its products according to the United States Department of Agriculture:

Milk.—Milk is the fresh, clean lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving.

Blended Milk.—Blended milk is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

Skim Milk.—Skim milk is milk from which a part or all the cream has been removed.

Condensed or Evaporated Milk.—Condensed or evaporated milk is milk from which a considerable portion of water has been evaporated.

Buttermilk.—Buttermilk is the product which remains when butter is removed from milk or cream in the process of churning.

Cream.—Cream is that portion of milk, rich in milk-fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force.

Butter.—Butter is the clean, non-rancid product made by gathering in any manner the fat from fresh or ripened milk or cream into a mass, which also contains a small portion of the other milk constituents, with or without salt.

Cheese.—Cheese is the sound, solid, and ripened product made from milk or cream by coagulating the casein thereof with rennet or lactic acid with or without the addition of ripening ferments and seasoning.

Whey.—Whey is the product remaining after the removal of fat and casein from the milk in the process of cheese-making.

Koumiss.—Koumiss is the product made by the alcoholic fermentation of cows' or mares' milk.

Kefir.—Kefir is a product made by a specific yeast fermentation of milk.

MILK ADULTERATION.

Milk is adulterated in several ways: (1) By addition of water; (2) by subtraction of cream; (3) by both addition of water and subtraction of cream; (4) by addition of coloring matter, thickeners, and certain harmless substances; (5) by addition of skim milk; (6) by addition of chemicals as preservatives.

Addition of Water.—This is one of the most prevalent methods for the adulteration of milk. It is so easy, apparently difficult of detection, and changes the appearance and general physical quality of the milk so little that it is often resorted to by dishonest dealers and producers. The addition of water to milk reduces its quality by diluting it, and the whole mass is less nutritious and has fewer food ingredients than normal milk. This is a harmful adulteration because it reduces the quality of the milk, and when fed to children proves injurious to their health. It is also a fraudulent adulteration because it substitutes an inferior product for the same price that the superior would sell for.

Extraction of Cream.—The extraction of cream, or what is called "skimming," is also a frequent mode of milk adulteration. It is perhaps even more in vogue among dealers than simple watering, because it is so much more profitable and difficult to detect. A forty-quart can of milk which sells for $1.60 will bring the dealer but 16 to 20 cents of additional profit when he adds four or five quarts of water to the can. If, however, the dealer removes two quarts of cream of the six or seven which the can contains he gains the price of the two quarts of cream (40 to 60 cents) less the price of the two extracted quarts, which amount to only 8 cents. This shows that the skimming of milk is a very profitable procedure, even when it is but partial. Indeed, a great deal of the milk in cans, which is sold at the markets and by grocers for a low price, is more or less skim milk.

Skimming and Watering.—Skimming of milk makes it heavier by subtraction of the fatty or lighter portion, thus increasing its specific gravity and density. A skim milk will read from 32 to 38 on the Quevenne lactometer and from 110 to 118 on the Board of Health lactometer, according to the amount of cream taken off. In order to disguise this higher specific gravity and to reduce it, dealers who make their own tests add sufficient water to reduce the density of the skim milk, so as to make the readings on the lactometer about the normal, and thus try to deceive the inspector who relies too much on the lactometer examination alone.

Skimming, as well as skimming and watering, reduces the nutritive quality of the milk and is a harmful as well as a fraudulent adulteration.

Addition of Skim Milk.—The addition of skim milk to normal milk reduces the quality of the whole milk and is harmful as well as fraudulent. One of the principal reasons for the prohibition of the sale of skim milk in some cities is the tendency of dealers either to sell skim milk for whole milk, or to reduce whole milk by the addition of the skimmed.

Addition of Coloring Matter and Other Harmless Ingredients.—The addition of coloring matter is mostly practised to disguise the poor appearance of skim or watered milk and make it look richer. The coloring matter most commonly used is a vegetable coloring "annatto."

The other colors used belong to the coal-tar family (azo-colors) and are harmful in comparison to coloring with "annatto," which is harmless. Their detection is possible only by chemical tests.

Sodium bicarbonate is sometimes added to milk which is beginning to turn sour, in order to disguise the acid taste. In small quantities the addition of soda is harmless, but the procedure is dishonest in that its purpose is to palm off milk which is acid for fresh milk.

Thickeners are very seldom put into milk, more frequently into cream and condensed milk.

Addition of Chemicals.—See p. 140.

MILK PRESERVATION.

Milk Deterioration.—The milk secretion of normal cows remains in a normal state for a comparatively short period, and important changes occur very soon.

If left undisturbed at the normal house temperature fresh milk shows some physical changes within six to twelve hours, and by this time it has also passed through certain chemicobiological changes. The physical changes are limited to the separation of the fat globules and the separation of the cream layer at the upper portion of the vessel containing the milk. There is also a reduction of the temperature of the milk from that at which it was voided to the temperature of the room. The other changes which occur are a souring which is slight at first and later increases. If milk is left at the same temperature for longer periods a distinct coagulation or curdling develops, owing to the hardening and separation of the casein. At the same time there is some gas formation and a bitter taste in the milk may become noticeable. All these changes are included in the term "deterioration" of milk. These phenomena are only the outward and noticeable changes; the real physical, chemical, and biological changes are, of course, more complex, and cannot be so easily detected. To what are these changes in the milk due?

Causes of Deterioration.—The separation of the cream is easily accounted for by the comparative lightness of the fat globules which coalesce and rise to the top. The other noted changes are due to the microorganisms. A perfectly sterile milk, that is, one absolutely free from bacteria, has never been obtained. Microörganisms are found in the ducts of the teats and udder of the cow, and even milk obtained by cannula already contain a certain number of germs. Immediately after secretion the milk begins to be contaminated with numerous germs from the air in the stable, the hands of milkers, the udder and teats of the cow, the surfaces of strainers, pails, etc., so that by the time the milk is taken out of the stable it contains a very large number of bacteria. The number of bacteria usually remains stationary for a few hours owing to the so-called "*germicidal*" power which the milk possesses at this initial stage of its existence outside the cow. Sooner or later, according to the condition of temperature, the bacteria begin to develop and multiply, so that after a certain time they are so numerous as to be counted by the million in the cubic centimeter.

The number of the bacteria is not the most important factor, but their importance lies in the *kinds* of the multiplying germs. These bacteria which get into and develop in milk are of several kinds.

In the first place there is the group of germs named "lactic acid" bacteria. By acting upon the lactose they convert it into lactic acid and thus favor the gradual souring which on reaching a certain stage causes coagulation of the casein with consequent curdling of the milk. Another group is composed of the "gas-forming" or "aërogenous" bacteria which are said to cause the gas formation in deteriorated milk. The butyric- and proteid-decomposing bacteria may also develop simultaneously with the lactic acid germs. There are numerous other germs which may at the same time act upon the milk. The lactic acid bacteria are important because they cause the souring of the milk and its subsequent curdling. As far as health and food value are concerned, lactic acid formation is not necessarily a harmful process. The ingestion of even very large quantities may not be harmful to health; indeed, in many cases it is even beneficial. Buttermilk and whey contain enormous quantities of the lactic acid germs, but are drunk with profit to health. They also possess another beneficial action in that they counteract other more harmful bacteria. While lactic acid fermentation is active and at its height, it is germicidal to other bacteria, which cannot develop in an acid medium. In may therefore be said with truth that the lactic acid fermentation process is not *per se* a harmful process.

The gas-producing, the butyric- and protein-decomposing germs are of more importance to health, because they are of harmful character. They produce putrefaction and decomposition, they develop a bitter taste and foul odors, and may also produce certain toxins, which may become very harmful to those ingesting the fluid.

Conditions Favoring and Retarding Bacterial Growth in Milk.—In view of the rapidity of the growth and the various characters of bacteria, it is important to note the conditions which favor and retard their growth and development. Generally, low temperatures, very high temperatures, absolute dryness, and certain chemicals are unfavorable to the life and growth of germ life.

Moisture and a temperature between 60° and 100° F., on the other hand, are very favorable.

Dryness.—Moisture is necessary for germ life, and bacteria develop very slowly, if at all, in a dry medium. It is, of course, difficult to obtain absolute dryness, which alone is inimical to bacterial life, but if milk is dried and kept in the form of a powder it may be preserved for some time, although this applies more to milk-powder from skim milk than to powdered whole milk, as the cream is said to become rancid if in powder form.

Low Temperature.—By low temperature is meant any temperature between 50° F. and the freezing-point. A low temperature does not destroy, but stops growth and development of bacteria. Their number remains the same, but they are in stunned form, always capable of doing mischief, even under these conditions. Thus it is known that typhoid fever bacilli may be alive for long periods even in ice or frozen milk, and such milk may therefore produce the disease. While bacteria do not grow in frozen milk, they do grow in milk kept at temperatures between 34° and 50° F., but only very slowly. The varieties which grow at these low temperatures are not the lactic acid bacteria, but those which are likely to do harm if the milk is kept too long at these temperatures. Milk kept at temperatures between 34° and 50° F. may be preserved for several days to a week and more, the lower the temperature the longer. The milk will not become sour, but it may become unfit for use because of the development of the other bacteria and their products.

Mean T mperature.—The effect upon milk kept at temperatures between 50° and 100° F. varies according to the degree of temperature and depends upon the kind of bacteria which the temperatures favor in growth and development and multiplication.

Various bacteria have a different and varying point of thermal death, as well as a temperature at which growth and development are most abundant. Lactic acid bacteria, for instance, develop most rapidly at a temperature of 60° to 70° F., at which they multiply more quickly than any other species. As their development is inimical to the growth of other germs, milk kept at 60° to 70° F. will sour and contain lactic acid bacteria to the exclusion of almost all others. At the higher temperatures between 80° and 100° F., the lactic acid bacteria do not always gain a predominance, but often others, especially the gas-producing bacteria, gain the upper hand and then in addition to the acid bacteria the milk contains other less desirable germs.

High Temperatures.—High temperatures, *i. e.*, temperatures above 100° F., are inimical and unfavorable to the life and growth of bacteria, and the various bacteria have their own thermal death-point. Some are destroyed at temperatures of from 120° to 140° F., kept up for a certain period; to destroy others requires, for an hour or more, a temperature above the boiling-point of water. Except for a few species, bacteria cease growing when the temperature is raised above 100° F. and begin to die when it is above 120° to 140° F., according to time of exposure to heat. At higher temperatures the bacteria are more quickly destroyed and in less time. Bacteria which bear spores are the most difficult to kill, and sometimes must be subjected to a very high temperature for a long time before they are destroyed. Most of the active germs, including the pathogenic bacteria of most common diseases, like typhoid, diphtheria, and tuberculosis, are killed at temperatures of 140° F. kept up for twenty minutes, and at higher temperatures kept up for less time.

Chemicals.—Certain chemicals are inimical to bacterial life and growth, although the number of these chemicals applicable to milk is, comparatively, very small (see page 141).

Milk Preservation by Cold.—As previously indicated, cold, *i. e.*, a temperature of from 32° to 50° F., does not destroy the germs in milk but merely inhibits and stops their growth and multiplication and thereby keeps the milk from becoming sour and decomposed. The length of time for which milk may be preserved by cold depends upon the number and the kind of germs originally in the milk before its temperature was reduced. It may vary from twenty-four hours to a week; frozen milk has been known to keep for longer periods, and is an article of commerce in Siberia and other northern countries. While the souring of the milk is undoubtedly postponed, it is not certain that its decomposition by other bacteria is avoided. Thus milk kept under low temperatures may keep sweet, and yet at the same time develop dangerous qualities. The main advantages of cold as a preservative are that it does not change the appearance and composition of the milk, and is valuable as an aid in preserving clean milk for a moderately short time. It must always be remembered that none of the germs are killed by cold temperatures and that the pathogenic bacteria may be as active as in warmer raw milk. Infected milk is therefore a dangerous milk to drink while raw, even if kept in a cool state. *Cold is only a valuable aid in milk preservation, nothing more.*

Milk Preservation by Sterilization.—Sterilization is the only method by which it is possible to make absolutely certain that milk contains neither bacteria nor their spores. It is the only method of preservation which rids milk of pathogenic bacteria.

Sterilization is defined as the "heating of milk to the boiling-point of water and above for a time sufficient to destroy all organic life and all bacteria and their spores."

Complete or *absolute* sterilization cannot be accomplished unless the milk is heated well above the boiling-point—220° to 240° F.—in autoclaves or sealed chambers under steam-pressure for a prolonged time, varying from one-half to two hours. This is the only means which assures complete destruction of all spores and pathogenic spore-bearing bacteria, like those of tetanus, etc. Simple *boiling* is also sometimes called sterilization. While this kills most germs and even a few spore-bearing germs, it does not make certain that all spores have been killed.

The objections to sterilization of milk, complete as well as incomplete, by boiling, are that certain changes are produced in milk by the heat. The effects of boiling and sterilization are as follows:

1. Change in color due to the browning or caramelization of the lactose.

2. Change in taste, the milk receiving a different cooked taste.

3. The destruction of all lactic acid bacteria, ferments, enzymes, as well as all other germs in the milk.

4. Coagulation of the albuminoid matter in the milk.

The sum of these changes is that the milk is not only less tasty, but is much less digestible and fit for food. For infant-feeding it has been found not appropriate, and some observers claim that it may cause scurvy and rickets.

Milk Pasteurization.—The word "pasteurization" has been so much used and missused that it is about time to discard it entirely, for it has no intrinsic meaning and simply confuses the minds of those who use it promiscuously. Pasteur's name is applied to a process which is carried out in many and various ways, and not always with scientific accuracy. The official definition of the term is "the heating of milk to a degree of heat sufficient to kill all most active germs; in general, the word is applied to any kind of heating of milk short of boiling. It is obvious that until a definite attempt is made to define the degree of heating and the time of heating and the exact procedure, the term will embrace various meanings, according to the whim and methods of each commercial or other concern using it.

As Rosenau says: "We should protest against a word which means a generality." And as he further remarks, the two main dominant factors that control the temperature and time at which the milk should be pasteurized are (1) "the thermal death-points of pathogenic bacteria, and (2) the ferments in the milk."

The aim and purpose of so-called pasteurization is (1) to kill all most active bacteria, especially pathogenic, (2) to leave the "ferments" unaffected, and (3) to change the milk as little as possible in its general appearance, taste, and digestibility. There is as yet no unanimity of opinion as to the degrees and time at which these conditions are reached. According to Rosenau a heating of milk for twenty minutes at a temperature of 140° F. absolutely destroys the tubercle bacilli, typhoid, diphtheria, dysentery, cholera, and other germs, but not all the necessary and valuable ferments in the milk. Not only the bacteria but their toxins, especially those of diphtheria and tetanus, are likewise destroyed at such a heating. There are, however, certain spore-bearing bacteria and bacterial toxins which remain unaffected at these temperatures. These spore-bearing germs are fortunately rare.

Chemical Preservation.—The difficulty of keeping milk sweet for a shorter or longer time after milking, led to the use of chemical preservatives. Among those formerly used are borax, boracic acid, salicylic acid, peroxide of hydrogen, and formalin. At present the use of any chemicals for milk preservation is strictly forbidden, although it is still more or less practised in secret. Borax and boracic acid were used in quantities of ten grains to the quart of milk. When used either singly or in combination they may preserve the keeping quality of the milk for twenty-four to forty-eight hours. Salicylic acid is a more powerful preservative, but its bitter taste makes it unfit for use except in very minute quantities. Formalin, which is a 40 per cent. solution of formaldehyde, is a powerful disinfectant. Even very small quantities can greatly enhance the keeping qualities of milk. One part of formalin to 50,000 of milk, or about one teaspoonful to a forty-quart can of milk, will keep the milk sweet for from twenty-four to forty-eight hours. The objections to chemical preservation are the following:

1. The chemicals referred to are even in minute doses injurious to health. As they are injurious to adults, it is apparent that they must be even more harmful when ingested by delicate or sickly infants, for whose use most of the milk is intended.

2. They change somewhat the digestibility of the milk. This is notably the case with formalin, which hardens the proteid matter.

3. A continuous and steady use of those chemicals will result in gastro-intestinal disturbances and intoxication, especially in children.

4. The use of chemicals, once permitted, even in minute doses, is bound to produce carelessness on the part of producers who will rely more upon the keeping qualities of the chemical than upon the cleanliness of production.

5. As soon as chemical preservation of clean and good milk is allowed, it will be impossible to prevent the use of chemicals in the case of bad, old, and partly spoiled milk, and this increases the danger of the use of milk.

The use of *harmless* preservatives has also been urged. Among these are peroxide of hydrogen, oxygen, and carbon dioxide. Peroxide of hydrogen is used in the amount of about two ounces to the forty-quart milk can. It destroys most of the bacteria and at the same time disappears itself in the form of free oxygen. The use of hydrogen peroxide has not been tried extensively. The chemical is comparatively expensive and its value as a preservative is problematic. Oxygen has been advocated as a disinfectant in milk; it is perfectly harmless and escapes after destroying the germs. The expense and the lack of proper apparatus have so far made this process impracticable. Carbon dioxide is said to destroy most germs in the milk when used under pressure of 75 pounds; the gas is harmless, does not change the character of the milk, and may be removed by aëration. This process is being exploited by a commercial concern, but its scientific and practical value still remains to be demonstrated.

MILK INSPECTION AND TESTING.

Methods of Examination and Testing.—The methods of examining and testing milk for the different impurities it may contain, and detecting the adulterations to which it is often subjected, are physical, chemical, and bacteriological.

Physical Examination.—By the physical examination are determined the appearance, color, odor, and specific gravity of the milk, together with the variations from the normal.

Chemical Examination.—This determines the exact amount of solids in the milk, also the exact percentage of each solid in the fluid.

Bacteriological Examination.—This determines the number of bacteria in the milk and the presence or absence of pathogenic bacteria.

Precautions.—The precautions to be taken in the examination of milk are: (1) That the milk is thoroughly mixed; (2) that it is not partly frozen; (3) that the milk to be tested has not been partly churned or partly separated from its cream; (4) that it is not partly or wholly coagulated.

In order to make proper tests, *fair samples of the milk* must be taken from a given quantity of the marketed milk, and precautions must be observed in the manner of taking samples, so as to obtain a fair and just sample of the whole quantity instead of only a small part of the fluid. For this a thorough mixing of the milk is necessary in order to give it uniformity.

Partly frozen milk will not give a good test, because the frozen part represents the watery part of the milk, and the rest of the milk will show a richer fluid and a higher percentage of solids.

Milk which has been partly churned and has butter granules floating in it, or milk from which the cream has been wholly or partly separated, will naturally not give the normal percentage of fat in the fluid; thus the sample of the milk taken may not be a fair sample of the whole fluid.

Milk which has been partly or wholly coagulated will not give a fair sample for testing because of the separation of the whey and solids.

Before samples are taken milk which is partly frozen must be thawed, so that the whole fluid becomes uniform; milk which has been partly churned and contains butter granules floating in it must be heated, so that these granules melt; milk which has been partly or wholly coagulated must be treated with alkalies sufficient to dissolve the coagulum; milk which has been partly separated from its cream must be thoroughly mixed and made uniform. In mixing milk care must be taken not to stir it too violently, so as to churn the milk or to mix it with air. The best means of mixing milk and of getting a uniform mixture is by pouring it from one vessel to another.

Physical Examination.—The physical examination of milk is of very great importance, and may give valuable information to the inspector. The color of the milk, its opacity, its resistance to the immersion of a lactometer, its adherence to the instrument, the visibility of the instrument through the glass test-tube, are all valuable indications in the hands of an experienced inspector. Milk which is bluish in color, which allows the lactometer to sink with little resistance, which runs down the instrument in thin bluish streaks, which hardly adheres to the instrument, and which is so little opaque that the instrument is readily seen through the test-tube, is a milk which is poor in solids and which is probably either skimmed or watered, or both skimmed and watered.

Cream Gauge.—Milk is often tested by the cream guage, pioscope, and lactoscope. The cream gauge is simply a graduated glass test-tube in which the milk to be tested is allowed to stand for twenty-four hours. At the end of this time the amount of the cream, as indicated in the yellowish layer on top, is read off. A good milk usually shows about 14 per cent. of cream. In order to facilitate the better separation of the cream, the milk is mixed with an equal amount of water and the resulting layer of cream is multiplied by 2 to show the actual amount of cream in the milk. The milk in the gauge should be put in a cold place, which favors the separation of the cream. This is a test upon which not much reliance can be placed.

Pioscope.—The pioscope (Heeren) is a small ingenious instrument to test the quality of milk by its opacity and color. The instrument consists of a small rubber disk with a small depression in its center, and of a glass plate painted in segments of varying shades of color, representing the color of cream, rich milk, normal milk, poor milk, skim milk, watered milk, etc. The inspector takes a drop of the milk to be tested and places it in the central depression of the hard-rubber disk, covers it with the glass plate, and compares the opacity and color of the milk with the various segments in the circle. In the hands of an experienced inspector this is a fairly trustworthy test.

Lactoscope.—The lactoscope (Feser) also tests the milk by opacity. The instrument consists of a graduated glass cylinder, in the center of which, at the bottom, is fixed a small white rod with several black lines on its face; 4 c.c. of the milk to be tested are put into the cylinder, making the black lines on the rod invisible through the opacity of the milk. The test consists in carefully measuring the amount of water needed in the cylinder to render the fluid transparent, and to make the black lines upon the rod visible. It is obvious that the poorer the quality of the milk the less water will it be necessary to add to the cylinder in order to make the mixture transparent; and, on the contrary, it will be necessary to add more water the richer the milk. The instrument is graduated and shows the amount of estimated fat in the milk according to the number of the cubic centimeters of water added.

Specific Gravity.—The testing of milk by its specific gravity is the test most frequently employed, and is very valuable in conjunction with the general physical examination of the milk.

The specific gravity of milk depends on the solids in the fluid. Of these solids, sugar and the proteids are heavier than water, while the fat is lighter. The specific gravity of average normal milk is 1.029, and may vary in normal milk between 1.029 to 1.032. The specific gravity is calculated at 60° F.

Milk which has been skimmed, *i. e.*, from which a part or the whole of the cream has been separated, will show an increased specific gravity, because the absence of the fatty portion will make it denser and heavier. A milk which is diluted with water will show a decreased specific gravity because it is made thereby much less dense and thinner.

Quevenne Lactometer.—The testing of milk with the Quevenne lactometer is based upon the relative specific gravity of the milk. This lactometer is graduated from 15 to 40, the scale reading as in ordinary hygrometers and showing the corresponding degree of specific gravity. A good milk (at 60° F.) will read 32 upon this lactometer, showing a specific gravity of 1.032, and average standard milk will read 29. A watered milk will read less than 29, according to the amount of water (0 being water), while a skimmed milk will read more than 32 up to 40, according to the amount of cream subtracted.

Lactometer of the Health Department of New York.—This instrument, extensively used in many places in the United States, is a larger instrument and is graduated differently from the Quevenne lactometer. According to this instrument it is assumed that 1.029 is the lowest permissible specific gravity for standard milk. The 29 degrees are divided into 100 subdivisions from the top figure 0 (showing the reading of water at 60° F.) to 100, which corresponds to 29 on the Quevenne instrument, or to the specific gravity of 1.029 on the ordinary hygrometer. The lactometer is graduated from 1 to 120. According to the Board of Health lactometer a poor market milk will read 100; a good rich milk will read between 100 and 110; a skimmed milk will read between 110 and 120; while a watered milk will read under 100, the amount of water added being indicated by the reading, *i. e.*, 10 per cent. of water has been added if the lactometer reads 90°, 25 per cent. if 75°, etc. This instrument is the most convenient for use, as the stem is longer and the degrees may be read more readily, and also the exact amount of the probable addition of water may be more readily calculated.

As the lactometric readings are calculated at 60° F., corrections must be made for any difference in the temperature of the milk above or below 60° F. When the difference in the temperature is very great it is best to reduce or increase its temperature to within 10° of 60°. The correction for the temperature is the 0.1 degree of the Quevenne lactometer for every degree of temperature, and 0.3 degree of the Board of Health lactometer for every degree of temperature above or below 60°; added to the reading when the temperature of the milk is above 60° F., and subtracted from the reading when the temperature of the milk is below 60° F. The usual rough correction for the Board of Health lactometer is 4° on the lactometer for every 10° on the thermometer, added or subtracted, according as it is above or below 60° F.

As the specific gravity of milk is increased by skimming and decreased by watering, some milk dealers first subtract a certain amount of cream, thus increasing the specific gravity and lactometer reading, and then add sufficient water again to decrease the specific gravity and lactometer reading to about normal, so as to deceive the inspector and give an adulterated milk a normal reading on the instruments. The only recourse of the inspector is then to compare the physical appearance of the sample of milk with normal milk, when there will appear the difference in the color, opacity, and density of the fluid.

Chemical Examination.—The chemical tests of milk consist in the examination to discover the exact percentage of solids, and the amounts and percentage of each component solid. The usual tests are those of weighing and evaporation for the exact amount of solids, and the Babcock test for the determination of the amount of fat in the milk. For the complete chemical and bacteriological tests of milk the student is referred to special works on the subject.

CHAPTER IV.

THE HYGIENE OF SCHOOLS AND OF SCHOOL CHILDREN.

THE SCHOOL CHILD.

By compulsory education the State forces children between the ages of six and twelve or fourteen to be sent to, and to be kept in, school for the greater part of the day during six or eight years. These years are the most important in life. They represent a period of formation, growth, and development. Having compelled the child to remain in school during the most important period, it is the duty of the State to take care not only of the mental growth and development of the child, but also of its moral and physical condition and development.

Not long ago it was deemed sufficient for the State to provide means and teachers for the cramming of the child's intellect with rudimentary knowledge of the elementary sciences. At present, broader ideas prevail. The child is the greatest asset of the State. The child's mental and moral development and growth go hand in hand with its physical growth and development. The school influences not only the child's mental growth, but profoundly affects its physical well-being. No care of the school child is therefore complete that does not take into consideration the physical condition and the bodily growth of the child as well as the prevention of the evil influences of school life upon its health.

What are the influences of school and school life on the physical well-being of the child?

These influences may be grouped as follows:

1. The influence of the school and the school room.
2. The influence of the age and growth of the child.
3. The influence of the methods of teaching and of the mental training given.
4. The influence of the herding together of a large number of children.

The Influence of the School and School Room.—No person of tender age may remain for six or seven hours a day during six to eight years in a place without being profoundly influenced by the condition of the place. The hygiene of schools begins, therefore, in the proper construction and care of school houses and school rooms.

The Influence of Age and Growth of the Child.—The child when it enters school at the age of six years weighs on the average forty-three to forty-five pounds, and its average height is forty-three to forty-four inches. When the child leaves school at fourteen years of age its average weight is one hundred pounds and its average height five feet. During this period the physical being of the child undergoes remarkable transformation; it is extremely sensitive to external influences, and its health must be carefully nurtured and promoted. It is imperative, therefore, to strictly supervise the personal hygiene of the child, its nutrition, clothing, dentition, physical development, etc. Mother and school are bound to take care not only of the child's unripe mind, but also of its unripe and growing body. This is accomplished by physical examinations of the child on its entering school, by supervision of, and provision for, its proper feeding, by the guiding of its muscular exercises, by providing baths, playgrounds, etc.

The eyes of the children need very careful attention. The light of school rooms, as well as the distance of the desks from the slate-boards, etc., must be properly adjusted, so that no harmful effects to the eyes ensue.

One of the diseases which are so frequently among school children is myopia. It is a disease directly due to school life, to study, to defective light and illumination, to improper positions, faulty seats and desks, defective methods of writing, too small print, and too much eye-strain generally. Children who come to school with some degree of weak vision gradually develop more pronounced near-sightedness, which increases in each grade of school. Thus in one New York school the percentage of myopics in lower grade 8 was 8 while in the higher grades it was 20.2.

The teeth of the children very often are effected by various defects and diseases, and these lead to certain malformations of the mouth, improper breathing, improper mastication, and improper development. With the ignorance prevailing among many classes of the population, it is impossible to depend upon the parents for the proper care and treatment of the irregularities of dentition, and the school through its dental surgeons should take care of this important field of hygiene.

There are certain diseases of the bone, rickets, deformities of the spine, etc. The latter especially are due to improper positions in school and may be prevented by taking proper care of the children within the school, by the adjustment of seats and desks, and by strict supervision on the part of the teachers of the positions and attitudes of the children during school work.

One of the most important defects among a large class of children is malnutrition. This is often due not so much to the lack of sufficient food as to the ingestion of improper food. Recent investigations have also shown that a great many children come to school breakfastless, and that many of them content themselves with but a very slight lunch, often consisting of ingredients insufficient for nutrition and improper for digestion. It is absurd to endeavor to teach the child and to train its mind while its body suffers from lack of nourishment. A healthy mind can exist only in a healthy body. It is the duty, therefore, of the school to provide for the proper feeding of the school children during school hours. This feeding should be given at a nominal cost to those who can afford it, and without any cost whatever to those children whose parents cannot afford the expense.

Influence of Teaching and Mental Training.—The methods of teaching and the subjects taught have an important influence, not only upon the mind, but also upon the body of the child. The unscientific and irrational methods of teaching as yet prevailing in many schools do much harm to the mind, injuriously influence the nervous system of the child, and do harm to the physical condition of the body. The preparation of a child for useful future citizenship does not mean the stuffing of his mind with useless book knowledge, to be forgotten as soon as he is out of school. The methods of teaching should be rather a training of the growing brain and mind, to gather for itself useful facts and to garner knowledge for its own use. The old hot-house methods of child culture are rapidly giving way to new natural methods of mental training.

Especially harmful to the child's nerves and physique are the present systems of competitive examinations, and the obsolete methods of punishment, etc.

The Influence of Crowding a Large Number of Children in the Schools.—This is the greatest evil of school life and the greatest danger to the health and lives of school children. A child in school comes in close bodily contact with other children, with a consequent possibility and probability of catching and spreading infectious diseases. The infectious diseases of school life may be grouped as follows:

Diseases of the Eye.—Conjunctivitis, blepharitis, pink-eye, granular conjunctivitis, or trachoma.

Diseases of the Skin.—Pediculosis, ringworm, scabies, impetigo, favus, molluscum contagiosum.

General Infectious Diseases.—Rötheln, measles, scarlet fever, diphtheria, typhoid, mumps, whooping-cough chicken-pox, etc.

The diagnosis of the various infectious diseases is within the province of the medical inspectors of schools. The exclusion of the children is made under the recommendation and order of these physicians.

The school nurses should have, and usually do have, general knowledge of the initial symptoms of the various infectious diseases. This medical instruction is given to the nurses in their medical curriculum, and may therefore be omitted here.

THE SCHOOL BUILDING.

The school is a place where children of tender age remain daily for long hours. The physical, mental, and moral conditions of the children during their school life is partly influenced by their sojourn in the school building. The preservation, therefore, of the health of the children demands that the school building be constructed and maintained in the best sanitary condition.

The sanitation of the school building should begin before its construction. The site for the school building should be selected from among the best in the town or city. The soil should be dry, porous, well-drained. The location should be distant from factories, markets, boiler shops, saloons, elevated railroads, and other establishments which for one or more reasons may become offensive and be a nuisance to the school. It is advisable to surround the school building with playgrounds and, if possible, with a public park.

There should be very little economy practised in the purchase of the site for the school building and in the construction of the building itself. Except in very small localities no school building should be of frame construction. Brick, stone, or reinforced concrete should be used.

The school building should be limited in height and should not contain more than four or five stories, preferably fewer. The school building should be constructed of fireproof materials and its inner trimming should be made fireproof.

The cellar and the lowest story should be dry, well lighted and ventilated. They may be used for the location of boilers, machinery, etc., but should not be used for workshops, gymnasia, or any other similar purposes.

There should be plenty of entrance and exit doors at frequent intervals. These should be broad, light, and fireproof, and should be sufficient to empty the building within a very short time in case of fire or panic.

The size of school buildings is best limited. It is better to construct three buildings for two thousand children each than one building to accommodate six thousand children.

The walls, floors, and ceilings should be soundproof and also proof against dust, damp, and vermin.

Some buildings demand a minimum of thirty square feet of floor space for each child.

The surfaces of walls and ceilings within the school should be smooth so that dust cannot adhere to them, should be easily washable, and painted with bright tints.

The subdivision of the school house into school rooms should be made by solid partitions if possible, reserving one floor with movable partitions for general assembly rooms, etc. The rooms should not be less than thirteen feet in height. The usual size of a school room is thirty by twenty-five feet.

Lighting.—The window area of school houses should not be less than one-fourth of the floor space. The top of the windows should be as near the ceiling as possible and should reach to about four feet from the floor. The best white glass, or preferably plate, should be used for the panes. Excessive glare should be controlled by appropriate shades from the top and the bottom of the windows. Electric lights should be used for artificial illumination.

Ventilation and Heating.—There has been much controversy as to the proper methods of ventilation for school buildings. There is no doubt whatever that school buildings, with the large number of children in the school rooms, cannot be ventilated properly by natural means, or by means of windows or openings in the windows, walls, or ceilings. There cannot be too much fresh air introduced into the school rooms. Provision should be made for artificial mechanical ventilation in all school buildings.

The installation of a proper mechanical ventilating plant is an engineering problem, the solution of which should be given only to most competent persons. The combined plenum and vacuum systems are the best for school ventilation. By this method the foul air from the room is exhausted through outlet openings in the school room, and the fresh air is introduced into the room through inlet openings in the same.

The advantage of this system of ventilation is that it may be combined with a system for heating and cooling the air which is introduced into the room. In the winter the air introduced through the tubes may be warmed by passing over steam coils, while in summer the air may be cooled by passing through a cold chamber.

Even in very small school buildings no local heating should be used. A hot-water heating plant may be cheaply installed even in small buildings. The combined heating and ventilating system must also make provision for proper regulation of temperature by thermostats.

Water Supply.—An ample supply of pure water should be had in every school room and there should be no need for the pupils to go long distances to obtain a drink. Sanitary drinking fountains are the best and all common cups should be prohibited. The filtering plant for the water supply of the school should be installed in a central location where it can be watched and kept clean.

There should be toilet accommodations of the best type on every floor of the building. The water closets should be provided with automatic flush so as to be self-cleansible.

Provision should be made for wash rooms, shower baths, swimming tanks, etc.

Cleaning.—The utmost care should be taken to keep all surfaces in the school room clean, and a routine daily, weekly, and periodical cleaning system should be adhered to. The obsolete method of cleaning by the feather duster or dry rag should be abolished. Whenever possible, vacuum systems should be installed in every school room. The school funiture and other surfaces should be cleaned daily with damp clean rags.

School Furniture.—The desks, seats, platforms, and blackboards should be properly constructed, and the desks and seats of the pupils should be made so as to be adjustable to the size of each child in order to prevent it from assuming improper attitudes while at work. The depth of the school room should not be too great and the distance of the rearmost pupil from the platform should not exceed twenty feet. It is best not to have the seats and desks attached to the floor, but to make them movable.

Some improved substitute is needed for the dust-creating chalk used on slate blackboards.

The Supervision of School Cleaning and Sanitation.—The common method of leaving all questions in regard to the care of the school building, rooms, and furniture to the janitor is entirely wrong. Each school should be supervised in its care and cleanliness by a trained school nurse who should have the supervision over janitors and cleaners, and whose duty it should be to make daily and hourly inspection of all parts of the school and to see that each part is properly cleaned and taken care of.

The appointment of such a supervising school nurse for the cleaning and sanitation of the school building would be of great benefit to the sanitation of the school and would greatly improve the health of the school children.

THE CARE OF THE CHILD IN SCHOOL.

The purpose of keeping the child in school from the age of six to fourteen and more is not only to give the child a mental training and education for use in its adult life, but also to promote the physical development and growth of the child into a healthy and useful citizen, capable of holding his own in the struggle for existence.

The mental and moral training of the child is given into the hands of teachers and principals, whose duty it is to devise and institute a proper system of intellectual activity and education and to give to the child the foundations of knowledge as well as a moral training. The various systems of teaching and of mental training, the selection of the courses, and of the teachers to guide the mental and moral training of the child, are in the province of mental hygiene and of the science of pedagogy.

The school has also a certain influence upon the health and life of the child and is the place where very often certain infectious diseases are communicated from child to child. A duty of the school authorities, therefore, is to prevent as much as possible the spread of these diseases.

These functions—the care of the health of the school child, the promotion of its normal growth and development, the prevention of general, and especially of contagious, diseases—are recognized as included in the hygiene of schools and have been intrusted to the school physician and to the school nurse.

FUNCTIONS AND DUTIES OF NURSES IN SCHOOLS.

Medical school inspection cannot be efficiently accomplished without the assistance and aid of the school nurse. She is an important and integral part of medical school inspection. Her special functions and duties in the school may be summed up as follows:

1. General and special assistance to the medical school inspector.

2. Preliminary inspection of children:

    (*a*) For detection of physical defects.

    (*b*) For detection of contagious diseases.

3. Visits to homes of children to investigate causes of absence from school.

4. Advice to children and their mothers on correction of defects and improvement of health.

5. First aid and emergency treatment.

6. Treatment of children for certain physical defects and contagious diseases.

General and Special Aid and Assistance to the Medical School Inspector.—With the present organization of medical school inspection and the small number of physicians assigned to this work in schools, it is absolutely impossible for the physicians to do good work or even to hope to efficiently accomplish the manifold purposes of medical school inspection. It is obvious that one physician assigned, as he often is, to three schools, with an attendance of from five to ten thousand children, cannot do more than routine perfunctory work. Even if there were assigned to *each* school *three full-time* physicians, the enormous amount of work could not be accomplished without the active aid and participation of trained school nurses. There is therefore great need for the appointment of many additional trained nurses for our schools. Indeed, it is claimed by competent school authorities that there should be assigned in each school at least one nurse to every two hundred or two hundred and fifty pupils.

Inspection for Detection of Physical Defects and Detention of Cases of Contagious Diseases.—A school nurse should be familiar with the height and weight charts of children and should be able to detect physical defects common to children. She should also be familiar with the symptoms of various contagious diseases with a view of their early detention and, at least, detention of those children who present suspicious symptoms for a more thorough diagnosis by the physician.

Physical Defects.—The physical defects common to children in school are the following:

Defective vision.
Defective hearing.
Defective nasal breathing.
Hypertrophied tonsils.
Tuberculous lymph nodes.
Defective teeth.
Malnutrition.
Chorea.
Orthopedic defects.

The more serious cardiac and pulmonary defects will be detected by the physician on his thorough examination of the child.

Defective vision and hearing may be detected by the application of simple tests.

Defective nasal breathing and hypertrophied tonsils may easily be detected by inspection and examination of nose and throat.

Tuberculous lymph nodes are detected by inspection and palpation.

Defective teeth aned malnutrition are detected by inspection, as are also orthopedic defects and more advanced cases of chorea.

Contagious Diseases.—The nurse on visiting each school should inspect the room which is assigned for the purpose of inspecting the children. The following contagious diseases are to be looked for.

Eye Diseases.—Acute conjunctivitis, pink-eye, trachoma, etc.

Skin Diseases.—Pediculosis, ringworm, scabies, favus, impetigo, molluscum, contagiosum.

General Diseases.—Mumps, chicken-pox, whooping-cough, German measles, measles, diphtheria, scarlet fever, smallpox, tuberculosis.

Exclusion of Children for Contagious Diseases.—Cases of acute conjunctivitis, trachoma cases, certain skin diseases and pediculosis, without live pediculi, may be allowed to attend school while under treatment, either by a private physician, a dispensary or the school nurse. Contagious skin diseases with extensive lesions, pediculosis with live pediculi, and all general contagious diseases are excluded from school attendance.

Home Visits by Nurse.—The nurse must exercise great tact in her visits to the homes of children who are absent from school. The purpose of such visits is to discover the cause of absence and the possible presence of contagious diseases and attendance at school of some members of the family. The nurse should not play the role of detective but rather that of family adviser and counselor. Children are often kept home for slight manifestations of illness which the nurse may recognize as symptoms of contagious disease. She should then advise the calling in of a competent family physician. In case of suspicious throat symptoms cultures may be taken by the nurse for bacteriological diagnosis. Reports must be made to the medical school authorities of the work and findings of the school nurse at the home of the patient.

Emergency and First-aid Treatment.—In the absence of the school physician all emergency cases are treated by the nurse in the school, whenever other treatment is not available. Slight or more severe injuries, cuts, results of falls, and other accidents occurring to school children in the school building should be promptly treated by the school nurse. It would be well if every school would provide a first-aid and emergency treatment room with the proper and necessary equipment and appliances. Children should be instructed to apply to the school nurse for the application of tincture of iodine for every slight scratch or cut in order to prevent possible septic infection.

Advice as to Physical Defects.—*Defects of the Mouth and Teeth.*—(*a*) If the child's teeth are decayed it should be taken to a dentist at once.

(*b*) The teeth should be brushed after every meal, using a tooth brush and tooth powder. The following tooth powder is recommended:

2 ounces precipitated chalk.
$\frac{1}{2}$ ounce powdered castile soap.
1 dram powdered orris root.
Mix thoroughly.

This prescription can be filled by any druggist at a cost not to exceed fifteen cents. The child should take the tooth brush and powder to the school and receive instructions from the nurse as to their proper use.

Defective Vision and Hearing.—Proper advice should be given to the children if defects in hearing and vision are discovered. A more thorough examination should be made by the physician with the view of prescribing exact treatment for remedying the defects. Errors of refraction should be corrected by properly fitted glasses. Special attention should be paid to any discharges from the ears as these may be symptoms of serious and contagious diseases.

Malnutrition.—Proper advice and counsel should be given to the child in case of manifect malnutrition. Correction of the dietary and advice to mothers as to proper feeding may be in the province of the school nurse. Anemia and malnutrition, when extreme, should be taken in hand by the physician and the child referred to special open-air classes and other methods employed for the cure of these conditions.

Treatment by Nurse of Certain Contagious Diseases.—*Pediculosis.*—A child affected with live vermin of the head or body should be excluded from school. The best treatment for the destruction of body lice is the boiling of the underwear of the child and fumigation of the clothing. The bathing of the child and instruction in cleanliness should follow the preliminary treatment.

Hair and Scalp Lice.—The best treatment for this affection is that with kerosene oil. Mix one-half pint of sweet oil and one-half pint of kerosene oil. Shake the mixture well and saturate the hair with the mixture. Then wrap the head in a large bath towel or rubber cap so that the head is entirely covered; the head must remain covered from six to eight hours.

After removing the towel the head should be shampooed as follows: To two quarts of warm water add one teaspoonful of sodium carbonate. Wet the hair with this solution and then apply castile soap and rub the head thoroughly about ten minutes. Wash the soap out of the hair with repeated washing of clear warm water. Dry the hair thoroughly.

Nits.—If the head is shampooed regularly each week as above described, it will cure and prevent the condition of nits. Common vinegar added to the shampooing mixture will greatly assist in separating the nits from the hair.

Methods of Treatment Employed by the School Nurse in Contagious Eye and Skin Diseases.—*Favus.*—*Ringworm of Scalp.*—Mild cases: Scrub with tincture of green soap and cover with flexible collodion. Severe cases: Scrub with tincture of green soap, paint with tincture of iodine and cover with flexible collodion.

Ringworm of Face and Body.—Wash with tincture of green soap and cover with flexible collodion.

Scabies.—Wash with tincture of green soap and apply sulphur ointment.

Impetigo.—Remove crusts with tincture of green soap and apply white precipitate ointment (ammon. hydrag.).

Molluscum Contagiosum.—Express contents: Apply tincture of iodine on cotton-covered toothpick.

Conjunctivitis.—Irrigate with solution of boric acid.

Trachoma.—Trachoma is not treated by the nurse. Children so affected are instructed as to the necessity for treatment, as per following instructions:

Instructions to Parents Regarding Trachoma.—Trachoma is a contagious disease of the eyelids. If left untreated it is very dangerous to the eyesight.

It first attacks the inner surface of the eyelid, later it spreads to the eyeball itself and causes loss of sight.

In the beginning the eyes may be red and watery, and they may, from time to time, contain matter, but often for a long time there are no symptoms that the person notices, and the disease is frequently first discovered by the doctor. It is very difficult to cure trachoma, and it is the more difficult the longer the disease has lasted. For this reason trachoma should be detected as early as possible. It is contagious when secretion, that is to say "matter," is present. This secretion is for the most part conveyed by means of towels, wash-cloths, and handkerchiefs, and persons with trachoma should always be careful that their towels, wash-cloths and handkerchiefs are used by themselves. It is therefore not on the street that trachoma is transmitted from one person to another, but most generally in the home, and it is therefore in the home that the greatest precautions should be taken.

Children who suffer from trachoma are not allowed to attend school unless they are regularly treated.

CHAPTER V.

THE HYGIENE OF OCCUPATIONS.

OCCUPATION AND HEALTH.

The functional activity of organs in the normal way is a physiological condition of health; the disuse, more or less prolonged, of any organ is, as a rule, followed by atrophic changes. While the normal pursuit of occupation is therefore a condition of health, pursuit of most occupations in the present industrial system is often followed by certain pathological changes in the human body.

It is certain that the health of workers is profoundly influenced by the kind of occupation they pursue, and that their very length of life is determined by their particular occupation. Occupation is a potent factor in the determination of human longevity. If the period of infancy and childhood and the hours devoted to sleep are deducted from man's life the greatest part of it is spent in industrial activity and is necessarily largely influenced by the occupation engaged in.

The relative number of those who die while in pursuit of their occupations bears an important relation to the healthfulness of the occupations. Mortality statistics clearly prove this contention. When the mortality of members of various trades is compared, a great difference in the rate of death per thousand is found. This difference frequently embraces long periods, large numbers, and many different countries, showing a uniformity in the increase of mortality-rates of the members of one trade over the mortality-rate of members of another trade.

It is shown, for instance, according to Ogle's tables from the experience of Great Britain, that clergymen have the lowest death-rate, next to them gardeners and farmers, while members of trades like bakers, tailors, liquor dealers, file-makers, and others suffer from a much higher mortality-rate. The mortality-rate of clergymen is therefore put as 100 in the following table as a basis for comparison:

Occupation.	Mortality-rate.
Clergymen	100
Gardeners	108
Farmers	114
Bakers	172
Tailors	189
Glass-workers	214
Liquor dealers	274
File-makers	300

The United States mortality tables also show that the mortality-rate per thousand of engineers and surveyors was 8.2; tailors, 11.8; printers, 12.1; carpenters, 17.2; cigar- and tobacco-workers, 18.7, and millers, 26.6.

Thus it is found that the mortality-rate of members of one trade is much higher than the rate for workers in another trade, and if the causes of the increased mortality are sought for, it is usually found that there are some specific dangers in the occupation which shows the highest rate of mortality.

Morbidity.—Not only the length of life of the workers is determined by their occupation, but also their state of health during life. If a physical examination of the workers in one trade is made, and the results are compared with those of a similar physical examination in another trade, a difference in the morbidity-rate, according to certain factors existing in each occupation, is usually found.

The experience of various sick benefit insurance societies in Germany, Austria, and other continental countries in which state insurance exists, shows a great difference in the rate of disease among the workers in different occupations. A recent medical examination undertaken by the New York State Factory Investigating Commission of 2283 persons, in the tailors', bakers', tobacco, and furriers' trades, has shown a large percentage of members of these trades suffering from one or more diseases.

Tuberculosis.—The most frequent disease in industrial life from which the members of various trades suffer is tuberculosis. Indeed, tuberculosis has been named an industrial disease. All statistics confirm this statement. They show that tuberculosis as a cause of mortality in active workers between the ages of twenty-five and forty-four is responsible for from one-third to one-half of all the deaths. According to statistics of the Prudential Insurance Company of America presented at the International Congress of Hygiene and Demography in 1912, tuberculosis was shown to be the cause of death of 35.5 per cent. of all occupied males between the ages of fifteen and twenty-four. Among farmers the rate at the same age was 33.1;

among clerks, 45.9 per cent; among glass-workers, 48.1 per cent.; among stone-workers, 47.8 per cent.; among plumbers, 42.1 per cent.; among printers, 49.5 per cent.; cigar-makers, 45.5 per cent.; tailors, 48.6 per cent.; textile-workers, 47.5 per cent.

Hoffman has also shown the great mortality among workers in dusty trades. According to Somerfeld, the mortality of Berlin workers in non-dusty trades was 2.39 per 1000, while in dusty occupations it was 5.42 per 1000.

Diseases of Occupation.—There are a number of diseases which are peculiar to certain occupations, and they have been therefore called industrial diseases. Among these diseases besides tuberculosis, which has been already referred to, the following are the most important:

1. *Respiratory Diseases.*—The term pneumonokoniosis is applied to an affection of the lungs due to the deposit of dust among its cells. Miners, charcoal drivers, metal and glass polishers, stone-masons and plasterers, and other workers in especially dusty trades are apt to have the dust lodge in their lungs, where it causes a special fibroid disease which eventually is followed by an infection with tubercle bacilli and frequently leads to death. Pneumonia, bronchitis, and emphysema are also frequently found among workers. They are due to exposure, difference in temperatures, and other factors in the occupation.

2. *Nervous Diseases.*—Among the nervous diseases which are frequently found among workers are those due to overstrain, tension, extremes of heat, shocks, and other untoward occupational factors. There are

also certain nervous diseases due to the overstrain of particular organs; the most common of these are writer's cramp, telegrapher's spasm, etc.

3. *Diseases of the Eye.*—Among the principal eye diseases are eye-strain, nystagmus, and other affections due to excessive light, heat, overuse, overstrain, and accidents.

4. *Infectious Diseases.*—A number of infectious diseases are due to infection by materials which are handled by the workers. The most important of these are anthrax, which is often found among workers with hides and cattle, ankylostomiasis, and others.

5. *Other Diseases.*—There are also a number of diseases of the digestive tract, of the skin, and of other organs, due to the various factors in various occupations.

Summary.—The effects of industries on health may be summed up as follows:

1. Sudden death due to accidents, falls, burns, explosions, etc.
2. Total or partial disability from the same causes.
3. Sudden deaths from acute intoxications by poisons, fumes, and gases.
4. Deaths from chronic intoxications by the same elements.
5. Deaths due to infectious material in industries.
6. Diseases due to direct action of dangerous elements in trades.
7. Diseases due indirectly to industries and occupations.

INDUSTRIAL FACTORS INFLUENCING HEALTH.

There are a number of factors in industry and various occupations which influence the health and bring about occupational diseases and the comparative shortening of the lives of industrial workers. They may be grouped as follows:

1. Personal factors.
2. Work place.
3. Working conditions.
4. Specific occupational dangers.

Personal Factors.—The personal character of the worker, his fitness for the occupation which he selects, his industrial training, his capital of bodily health and mental training, his vital resistance, his age and sex, all are important factors determining the influence of the work upon the worker.

The greater the sum of health with which the worker starts out at the beginning of his career the more efficient will be his work, and the less likely will it be that he will suffer from the adverse conditions incident to his work. His susceptibility and vital resistance depend partly on his physical health and partly on individual idiosyncrasies. There are, for instance, those who are less susceptible to certain poisons than others, enjoying a certain immunity against the effect of infections and poisons to which others quickly succumb.

The proper selection of a trade according to fitness is very important. A feeble individual selecting a trade which requires strenuous physical exertion will succumb sooner to the effects of the trade than a robust worker.

Age.—The age at which work is begun is also of great importance. There are nearly 2,000,000 children under the age of sixteen employed in the various occupations in the United States. That the developed organism is unable to withstand the strains of continuous and prolonged muscular or other exertion is obvious. The mind and body of a child under sixteen should be carefully nurtured and not allowed to be subject to physical or mental strain for long periods. In normal society there should be no economic cause for parents of children under sixteen to need the wages of the child workers or to impose the burden of economic independence upon the physically unripe child. The effects of labor on children may be summed up as follows:

1. Injury to the weaker organism.
2. Interference with their growth and physical development.
3. The production of special and other bone deformities.
4. The lowering of vital resistance and the predisposing of the body to disease.
5. The stunting of mental and moral development.
6. The physical, moral, and mental degeneration.
7. The shortening of life.

The Labor of Women.—Under the present economic conditions a large number of women are employed in gainful occupations, and form a very important part of the industrial population. There is hardly a trade or industry in which women do not participate.

The question what effect, if any, occupation has upon women has been studied by many investigators, and certain conclusions have been reached which are at present universally accepted. These conclusions regarding women's labor may be summed up as follows:

1. That there are certain forms of labor, especially those requiring great physical exertion, which should not be followed by women because of their comparative physical weakness.

2. That women cannot bear with impunity as long hours of labor as men; that therefore the hours of labor should be shortened, and should not exceed eight per day.

3. That there are certain periods each month during which women should not be allowed to work at all, because they are in a semipathological state.

4. That women who bear the burden of pregnancy and childbirth should not be allowed to work during these periods.

5. That night work is injurious to the health of women.

6. That those women who are burdened with the care of children or of a household should not be expected to participate in industries to the same extent as those who are free from these burdens.

7. That owing to the greater susceptibility of women to certain industrial poisons, they should be excluded from work in all industries in which these poisons are produced.

The Work Place.—The place where the work is carried on has a great influence upon the health of the worker. The effect of the factory or workshop upon the health of the worker depends upon its proper construction, upon the fire protection, the provision for light and illumination, adequate ventilation, proper heating, the drainage, plumbing, and general sanitation of the place.

At present much work is done at home, especially by women and children. The injurious effects of "home work" or "sweat-shop work" are due partly to the unsanitary conditions under which the home-workers are compelled to work, and partly to other causes, such as the tendency in home work for small children to participate, the longer periods of the work at home, the danger that the home will be infected by the dust and manufactured materials brought into it, or that the materials will carry infection from the home. A great many of the factory buildings are entirely unsuited to the purpose of manufacture and are unfit for the workers. The existence of so many unfit factories is a cause of a great many of the evils of modern factory system. The dangers from fire in factories and workshops, as they are ordinarily constructed, are very great. These dangers are due to:

1. The congestion of factories in certain areas.
2. The too great height of many buildings in large cities.
3. Faulty internal construction.
4. Bad internal arrangements.
5. Too many workers on each floor.
6. Insufficient exits.
7. Improper exits.
8. Insufficient fire-escapes.
9. Inadequate means of extinguishing a fire and of preventing panic.

Another of the great dangers in many industrial establishments is due to the improper safeguarding of machinery. It has been estimated that there are nearly 1,000,000 accidents to workers in the United States every year, and that several hundred thousand persons are disabled, while many thousands are killed outright, through accidental injuries in factories. Most of these accidents can be prevented and avoided by the proper safeguarding of machinery; and the hazards of industry may be greatly reduced by proper care on the part of the employers and managers to whose care the lives of the workers are intrusted.

The proper light and illumination of the work places are of great importance to the health of the workers. It is to the interest of the employer that the workman should be able to see what he is doing. It is to the interest of the work itself that the worker should not strain his eyes in the performance of his functions. A large number of factories and workshops are improperly lighted and illuminated, causing injury to the eyes and general health of the workers.

The provision of sufficient air in workshops is of the utmost importance to the health of the worker. Labor in confined rooms is injurious to the health, does not furnish sufficient oxygen to the body, compels the worker to inspire deleterious substances, and predisposes him to various diseases, especially tuberculosis. During work more air is needed than during repose, and it is of the greatest importance that workshops should be well ventilated and the air therein be of a proper temperature, not overheated, and frequently changed.

While it is possible to provide adequate ventilation in homes and dwellings by natural methods of ventilation, such as windows, doors, transoms, and occasionally special devices, it is of the utmost difficulty to provide adequate ventilation in factories and workshops by these methods. In all factories and workshops there should be provision made for artificial ventilation by mechanical means, which should allow the entrance of a large volume of air into the workshops without draughts, and every effort should be made to insure an equable temperature in the workshops.

The general sanitary cleanliness of factories and workshops is important to the health of workers. There should be provision for an adequate number of wash rooms, dress rooms, lunch rooms, emergency and rest rooms, as well as insurance for the cleanliness of the walls, ceilings, floors, and windows; for the proper disposal of rubbish and garbage; the prevention of spitting on floors, and provision for toilet accommodations and their cleanliness.

Working Conditions.—Besides the personal factor and the influence of the place of work there are many other conditions in industrial life which have a deleterious influence upon the health of the worker. Among the most important of these conditions are:

1. Too glaring light.
2. Too great relative humidity of the air in the shops.
3. Extremes in temperature.
4. Improper positions and attitudes during work.
5. Great differences in the air-pressure.
6. Too prolonged work and exertion and consequent overfatigue.

7. Insufficient pauses during work.

8. Too great tension and physical or mental strain during the work.

9. Last but not least, inadequate compensation of the workers.

The other injurious influences to which the industrial population is exposed are improper standards of living, ignorance of personal hygiene, the unsanitary housing of the working classes, improper feeding, etc.

SPECIFIC OCCUPATIONAL DANGERS.

There are certain specific dangers found in many trades and industries. These dangers are mostly due to the materials which may be grouped as follows:

1. Infectious materials.
2. Dusts.
3. Poisons, gases, and fumes.

Infectious Materials.—Certain materials, like garments, underwear, rags, etc., may be infected with the germs of scarlet fever, typhoid, diphtheria, etc., and spread infection to the workers. Gardeners may be infected with tetanus; horsemen and coachmen with glanders; tanners, wool-workers, etc., with anthrax; nurses with the various communicable diseases of the persons of whom they are taking care; tunnel workers with ankylostomiasis.

Dusts.—There are many industries in which a great amount of dust is created during the work. The effects of the dust upon health vary with the amount of dust inhaled, the kind and character of the dust, the period of exposure, the individual health of the worker, and many other factors. All dusts cause some irritation to the mucous membrane of the eyes, nose, mouth, and throat. Metal or mineral dusts may also cause mechanical injury to the mucous membranes of the respiratory passages.

Hoffman classifies dusty trades according to the dust produced, as follows:

GROUP I.—*Exposing to Metallic Dust:* Grinders, polishers, tool- and instrument-makers, jewellers, goldbeaters, brass-workers, printers, compositors, engravers, pressmen.

GROUP II.—*Exposing to Mineral Dust:* Stone-, marble- and cement-workers, glass-cutters, diamond-cutters, potters, plasterers, paperhangers, molders, core-makers, lithographers.

GROUP III.—*Exposing to Animal and Mixed Dust:* Furriers, taxidermists, hatters, silk-, wool-, and worsted-workers, carpet-, rug,- rag-, and shoddy-workers, hair-mattress-makers, upholsterers, etc.

GROUP IV.—*Exposing to Vegetable-fiber Dust:* Cotton ginners; textile, flax, hemp, cordage, and paper manufacturers; weavers, spinners, hosiery knitters, lace-makers, jute and wood-workers.

According to Hoffman, the mortality-rate from consumption varies according to each group. Thus the mortality-rate in metallic trades is 37.4 per cent.; that from organic dust is 23.7 per cent.; from mineral dust, 28.6 per cent.; from vegetable dust, 27.4 per cent.; from animal and mixed dust, 32.2 per cent.; in all dusty trades, 28 per cent.

Industrial Poisons.—Many poisons are either produced or found in industries and industrial processes.

The list of principal poisons published by the Department of Commerce and Labor includes over fifty, among which lead, arsenic, mercury, zinc, phosphorus, and chromium undoubtedly cause the greatest injury.

Lead.—There are innumerable trades in which lead is used in one form or another, and the workers often suffer from lead poisoning. Lead enters the system chiefly through the digestive tract, but also through the lungs and skin. The effects of lead poisoning are the following: Constipation, abdominal cramps, or lead colic, anemia, blue line on the gums, pain in the joints, temporary blindness, "wrist-drop," loss of motive power in hands and feet, progressive muscular paralysis, multiple neuritis, leading sometimes to convulsions and insanity. The workers most frequently affected are those who work in the lead factories and smelting works, printers, type-founders, lithographers, potters, enamel-makers, plumbers, painters, glass-, gold-, silver-, and patent leather-workers. The laws protecting workers from lead poisoning in this country are very inadequate. Women and children suffer more from lead poisoning than men, as their susceptibility to the poison is much greater.

Arsenic.—This poison is extensively used in the arts and trades. Arsenic affects the skin, the digestive tract, and the respiratory and nervous systems. The effects of arsenic are skin eruptions, catarrhal inflammations, colic, indigestion, nerve disturbances, progressive muscular atrophy, etc.

Mercury.—Mercury is used in many trades and may injuriously affect the workers. They come in contact with it in quicksilver, gold, and silver mines, in the manufacture of barometers, thermometers, electric meters, in the manufacture of drugs, in the felt and fur industries, in the manufacture of artificial flowers, in powder works, in photography, and in various chemical works. Mercury is introduced into the system by inhalation of the fumes, by ingestion of the salts, and by absorption through the skin. The effect of mercurial poisoning is manifested in stomatitis, gastric disturbances, a metallic taste in the mouth, ulceration of the gums, nerve paralysis, loss of memory, and other nervous disturbances.

Phosphorus.—The danger of phosphorus poisoning is limited almost entirely to workers in match factories. Its effects are manifested in gastric disturbances and in caries of the teeth, and necroses of the bone of the jaw. Under the present federal law the manufacture of poisonous phosphorus matches is to be eliminated entirely.

Other Poisons.—There are several other poisons which injuriously affect the workers. Among these the most important are chromium, zinc, aniline, and others, which are employed principally in the chemical trades.

Gases, Fumes, and Vapors.—There are also many industries in the processes of which dangerous gases, fumes, and vapors are produced. Some of the principal gases and substances from which injuries fumes arise, are: Sulphuric acid, sulphuretted hydrogen, and other sulphur compounds; carbon monoxide, carbon dioxide, carbon bisulphide, and other carbon compounds; nitric acid, hydrochloric acid, ammonia, chlorine gas, iodine, bromine, petroleum, benzine, nitrobenzol aniline dyes, and all coal-tar products; chromium, potassium, alum, iron, lead, turpentine, cyanogen compounds, dynamite, etc.

The dangers from gases and fumes depend on the toxicity of the substances, the irritating nature of the fumes, their corrosive action upon skin and mucous membranes, the danger from burns, scalds, and explosions, and finally upon the excessive temperatures of the places in which these gases are generated.

The way in which these gases enter the system differs from that of dusts or poisons. While dust acts principally upon the respiratory system, gases and fumes have specific action upon the eyes, mucous membranes, and the blood. Some of the fumes which are the products of various industries act as virulent poisons, and their action may prove fatal within a short time after exposure, as, for instance, after inhaling gases like carbon monoxide, sulphuretted hydrogen, bromine, chlorine, cyanogen, etc. The effects of irritating gases and fumes upon the eyes, the skin, and mucous membranes are very marked in the numerous skin affections, erosions of the mucous membranes of the nose and mouth, and the various ulcerative and inflammatory changes in the skin of hands, fingers, face, and arms.

INDUSTRIAL BETTERMENT.

In order to prevent the injurious influences of prevailing industrial conditions and to promote the health of the workers many of the industrial evils which have been enumerated must be abolished by means of proper legislation for the protection of workers, strict enforcement of the law, and the spread of education among both employers and workers.

Many of the industrial factors which are inimical to the health of the employees are not necessary. unavoided, and may easily be prevented by proper care and thoughtfulness on the part of the employers or managers. Many other injurious influences can be avoided by special devices and protective care.

In the following pages an attempt is made to give a brief summary of the vast subject of industrial betterment and workers' welfare.

Age.—No child under sixteen is physically ripe for continuous muscular exercise, and no child under that age should be permitted to be at work in gainful occupation. The period of life between six and sixteen should be devoted to physical, mental, and moral training, growth and development, and not to the economic exploitation of the child.

Sex.—There should be legislative restriction (1) of the kind of work women may do, (2) of their hours of work, (3) of their work during certain periods.

Women's work in many forms of labor, especially when there are abundant dusts, specific poisons, and extra hazardous machinery, should be either entirely prohibited or greatly restricted. The consensus of opinion of all investigators is that eight hours of daily work should be the limit for female labor and that night work for women should be entirely prohibited. It also goes without saying that women should not work during pregnancy or during lactation, and that special provision should be made for women during their monthly semipathological periods.

Home Work.—Home work is at present greatly restricted in many States. The aim should be to abolish it entirely, as the home should not be converted into a workshop.

Selection of Trade.—With a proper system of primary and industrial education and vocal guidance, the selection of a proper trade in conformance with the physical condition of the worker would be greatly facilitated. A rigid preliminary physical examination by competent medical examiners would prevent the entrance of the physically unfit or of weaklings into a trade which requires robustness, great physical power, and endurance.

Education.—The education of workers in matters of personal hygiene, in the protection of their own health and lives, and in the avoidance of the injurious influences of industry, would be a great gain and would prevent many industrial diseases and resultant evils.

The Work Place.—The sanitation of the work place is of the utmost importance to the worker and should be under the supervision of State authorities, who should require a license for the establishment of factories and workshops. The licenses should be conditioned upon the proper construction, size, plan, and arrangement of the building. The walls, floors, ceilings, and all other surfaces in factories should be smooth, without crevices, nooks, corners, moldings, etc., and should be finished with some non-absorbent, light-colored material, easily washed off and cleansible.

Special care should be given to fire protection and the avoidance of dangers from fires and panics. The height of the buildings in which factories are located should be limited, and the number of occupants on each floor should be limited also. The construction of all buildings where a large number of workers are congregated should be absolutely fireproof, with an installation of all modern fireproof devices, such as automatic fire sprinklers, extinguishers, etc. There should be ample means of exit, which should be enclosed in fireproof partitions, and there should be on every floor a zone of safety to which the workers may escape to remain there for a certain period during fire or panic. Frequent fire drills are also necessary in order to insure discipline among the workers and to prevent panics.

The provision for proper light and illumination of factories should be in the hands of capable illuminating engineers, and the intensity of light for a given place should be properly calculated according to the various exigencies of each trade. Artificial illumination should be controlled so as to avoid the glare which is likely to injure the eyes of the workers or to cause undue eye-strain.

Special provisions for insuring the purity of the air in shops should be taken by compulsory provision of artificial illumination and ventilation in all factories where a large number of persons are at work.

The greatest care should be taken in providing ample washing facilities, a pure water supply, a sufficient number of dressing rooms, and properly cleaned and well-flushed toilet accommodations.

The cleaning of the work rooms should be the duty of specially appointed persons, and should be carried out by methods which prevent the raising of dust and insure cleanliness in the shops.

There should also be some provision in especially large factories for rest rooms, emergency rooms, first-aid and hospital service, and also for lunch rooms and some forms of periodic recreation.

Prevention of Specific Occupational Dangers.—To prevent industrial infection from hair, hides, clothing, etc., all suspected material must be thoroughly disinfected and fumigated, and the employees must be taught to take proper precautions in handling such products by explaining to them the modes of infection.

Prevention of Dust.—The evil effects of dust in industry may be prevented by the following measures:

1. Separation of the dusty processes from the less dust-producing processes and the isolation of these dusty processes in specially constructed rooms.

2. The instant and continuous removal of all dust created at the place of production, by special vacuum hoods and tubes covering every dust-producing process, all dust being exhausted by fans operated by one central motor.

3. Substitution of machinery for handwork in all processes where the workers are exposed to dust and where mechanical means, which will cover the dusty process and prevent the dust from coming in contact with the workers, cannot be devised.

4. Substitution of the wet method for dry production, that is, all materials producing dust, should be well moistened during the process of manufacture.

5. By isolating the worker from the dusty process. This may be accomplished by separating the worker from the dust-producing process by a glass or other partition or screen, and by inducing each worker to wear properly adjusted respirators in order to prevent the entrance of the dust into the nostrils and mouth.

Prevention of Poisons, Gases, and Fumes.—The prevention of the effects of industrial poisons, gases, and fumes does not differ in principle from the prevention of injury from dust. There are a number of poisons for which non-toxic substances may easily be substituted. This has been done already in a number of cases. Yellow phosphorus, now prohibited in manufacture, has been replaced by red phosphorus; nitrate of silver has been substituted largely for mercury in the manufacture of mirrors; and in pottery production a leadless glaze is now being introduced. The removal of gases and fumes may easily be accomplished by means of proper ventilating devices.

Prevention of Accidents.—The prevention of accidents due to machinery and other causes is a most important part of industrial hygiene. Motors, engines, and flywheels should be fenced in and provided with proper guards and rails. Wheels, shafts, drums, belts, gearings, etc., should be enclosed and protected by special devices. There should be in every establishment a rigid inspection by the foreman and by experts in the proper safeguarding of machinery.

Factory Inspection.—Factory inspection is already a recognized State institution, and has done much toward the amelioration of the conditions of labor. In order to increase its benefits, part of the control of industries should be in the hands of qualified physicians. Medical factory inspection is a demand of modern industrial hygiene no less than medical school inspection. Comprehensive medical factory inspection embraces the following features: State licensing of trades and industrial establishments; preliminary physical examination of applicants for employment; periodic medical inspection and examination of workers; exclusion of all who are physically unfit or suffering from incipient disease; sanitary inspection of places, of trades, and all sanitation. Medical factory inspection is already established in many European countries, where its great value in relation to public health has already been recognized.

Public control of environmental conditions, improvements in the housing of the working classes, spread of education, better systems of popular nutrition, and similar sanitary improvements are already included in the duties of social workers and form a part of public health progress.

Health Insurance.—Finally, the promotion of public health demands the institution of new measures for the protection of the workers, as well as the general community, by means of compulsory industrial insurance. Insurance against accidents, against sickness, against death, against unemployment, and similar insurance is already in vogue in many countries, and this principle is rapidly spreading and promises to become one of the most important elements in industrial legislation and industrial welfare.

FUNCTIONS AND DUTIES OF THE FACTORY NURSE.

The recognition of the importance of the human factor in modern industry has led owners of industrial establishments to improve the sanitary conditions of their factories and to take better care of their employees. A large number of factory owners have appointed physicians as sanitary supervisors of their plants and medical examiners of their workers, and advisors and consultants in the prevention of occupational and vocational diseases.

The trained nurse is also playing a very important role in factory sanitation and in the field of industrial hygiene. A large number of nurses have been and are constantly being appointed in various plants to assist the physicians in their work of increasing the health and efficiency of the workers.

The functions and duties of the factory nurse are as follows:

1. First-aid and emergency treatment.
2. Care of the health and physical condition of women workers.
3. Inspection and supervision of sanitary comforts, lunch rooms, recreation, etc.
4. Investigation of causes of absence of workers.
5. Visits to the homes of workers and hygienic advice to their families in their homes.

Perhaps the most important function of the factory nurse is the giving of first aid for minor accidents in the shop and treatment and advice given to women workers for slight ailments, etc.

A number of industrial codes make legal provision for nursing service and for the provision of first-aid kits in the factory. The New York Industrial Code provides for a first-aid kit in every factory employing more than ten persons in which power-driven machinery is used for manufacture.

The first-aid kit must be made of metal or glass and be dustproof. The contents of the kit are:

Instruments: Scissors, forceps, tourniquet.

Drugs: Aromatic spirits of ammonia.

Four per cent. solution of boric acid.

Tincture of iodine.

Collapsible tube of vaseline with bicarbonate of soda.

Castor oil.

Various dressings.

The first-aid box will naturally vary according to the character of the industry and work done in the shop.

The prompt treatment of small wounds and injuries by the nurse by application of tincture of iodine and suitable measures in slight burns, eye injuries, etc., are not only a great saving to the employer by prevention of compensation cases, but also a means of preventing serious effects upon the health of the workers.

The time is not far distant when every modern factory will employ at least one nurse for every one hundred or one hundred and fifty employees in the establishment.

CHAPTER VI.

INFECTIOUS DISEASES AND THEIR PREVENTION.

I. General Considerations: The Infectious Diseases—Classification—Stages—Morbific Agents—Portals of Entry—Modes, Vehicles and Agents of Transmission.

II. Principles and Practice of Prevention: Mortality—Progress in Prevention—Methods of Prophylaxis—Individual Immunity, etc.—Disinfection—Social Measures of Prophylaxis.

III. The Role and Functions of the Nurse in Prevention of Infectious Diseases: Public Health Nursing—District Nurses—Nursing in Tuberculosis—Measles—Scarlet Fever—Diphtheria—Pneumonia—Typhoid—Poliomyelitis—Erysipelas.

GENERAL CONSIDERATIONS.

Diseases are divided into two principal groups, constitutional and environmental.

Constitutional diseases are such as are due to organic and structural defects in the body organism, such as diseases of circulation, digestion, metabolism, etc.

Environmental diseases are due to extrinsic factors, external interference and to the invasion of the body by morbific agents.

The prevention of constitutional diseases is within the scope of personal hygiene.

The prevention of environmental disease is within the functions of public hygiene and sanitation, because the etiological environmental factors are those which usually act in large groups and upon large masses of people, and also because the prevention of such diseases is only possible with the help and coöperation of the whole community.

The most important environmental diseases are those which are variously termed infectious, communicable, contagious, pestilential, parasitic, zymotic, etc., but which are all included under the one term communicable diseases.

The following is a list of communicable and infectious diseases, alphabetically arranged:

Actinomycosis.
Anthrax.
Chicken-pox.
Cholera.
Dengue.
Diphtheria.
Dysentery:
  (*a*) Amebic.
  (*b*) Bacillary.
Favus.
German measles.
Glanders.
Gonococcus infection.
Hookworm disease.
Leprosy.
Malaria.
Measles.
Meningitis:
  (*a*) Epidemic cerebrospinal.
  (*b*) Tuberculous.
Mumps.
Ophthalmia neonatorum.

Paratyphoid fever.
Plague.
Pneumonia (acute).
Poliomyelitis (acute infectious).
Rabies.
Rocky Mountain spotted or tick fever.
Scarlet fever.
Septic sore throat.
Smallpox.
Syphilis.
Tetanus.
Trachoma.
Trichinosis.
Tuberculosis (all forms, the organ or part affected in each case to be specified).
Typhoid fever.
Typhus fever.
Whooping-cough.
Yellow fever.

The majority of the communicable diseases have been found to be caused by the entrance into the body of certain microörganisms of animal and vegetable origin. These microörganisms live, develop, reproduce, increase and multiply within the body or the body organs and either directly destroy vital tissues and important organs or evolve certain toxic products which interfere with proper body metabolism or cause pathological changes constituting the specific symptoms and signs of the various diseases.

The chief characteristic of most of these diseases is that they are communicated and transmitted from one person to another person either directly or indirectly, by contact or through the medium of certain objects, in one way or another, or in several ways combined.

The communicable diseases are classified according to the shape, characteristics, and character of the morbific agents which cause them, or according to prominent symptoms or groups of symptoms, skin lesions, etc., which each or certain groups represent, or according to the mode, vehicle and agent of transmission.

Infectious diseases are characterized by having certain stages, such as exposure, infection, invasion, incubation, acme, decline, etc.

The stage of exposure is the time during which the person is exposed to the presence of morbific agents.

The period of infection is the period of actual entrance of the morbific agents into the organism or system.

The stage of incubation is the period of actual development of the morbific agents within the organism, or the period of the active struggle for existence between the infecting agent and the defensive forces of the body.

The period of invasion is the period during which the infecting morbific agents, having won their battle, the definite symptoms of disease (the prodromal stage), begin to manifest themselves.

The stages: acme, decline, and convalescence, are characterized by the height, the decline of disease, and recovery.

The degree of infection depends upon the number of morbific agents, their virulence, the mode of entrance, and the vital resistance of the body.

The incubation period depends upon the specific character of the invading morbific agents, and varies with different diseases.

Decline of the disease is either sudden, by *crisis*, or gradual by *lysis*. Convalescence may also be delayed by "recurrence" or "relapse."

The disease may also be of acute, subacute, or chronic, severe or mild, remittent or intermittent.

Infectious diseases are termed *endemic* when they appear continuously in one locality, *epidemic* when they affect a large number of persons at one time, and pandemic when they cover a vast area of land or several countries.

The three most important features of infection and infectious disease are the following:

1. The morbific agents.
2. The portals of entry.
3. Modes, vehicles, and agents of transmission.

1. **Morbific Agents.**—The belief that certain diseases are caused by some living agents outside of the body is old and has been held by many ancient observers, but the proof has only become possible after the perfection of the microscope and with the extensive research into the microörganic world which this instrument has made possible.

To Pasteur, of France, and to Koch, of Germany, we owe the establishment upon a scientific basis of the new *science of bacteriology*, to the researches in which we owe the definite proof that certain diseases are directly caused and are due to specific microörganisms, which invade and infect the human body and, by their activity and products, cause the pathological changes and train of symptoms which we call infectious diseases.

The microörganisms which act as morbific agents of disease are of animal or vegetable origin, mostly of the latter.

The animal parasites belong to the protozoa, insects and worms.

The vegetable microörganisms are grouped under the general group of bacteria, which signify minute unicellular plants and which are subdivided into a number of groups and types; one important subdivision being according to their external form; thus, the cocci are so named because of their spherical form, the bacilli have a rod-like elongated form, while the spirilli have a spiral form.

While millions of these vegetable microörganisms are entirely innocuous, there are among them certain species which, entering under favorable conditions into favorable soil in the human organisms, become pathogenic and are to be looked upon as the morbific agents of disease.

Among the more important pathogenic cocci are the following: Staphylococcus pyogenes aureus, Streptococcus pyogenes, pneumococcus, and the gonococcus.

The following are some of the pathogenic bacilli: Bacillus anthracis, Bacillus edematis maligni, Bacillus tetani, Bacillus typhosus, Bacillus tuberculosis, Bacillus mallei, Bacillus lepra, Bacillus diphtheriæ, Bacillus influenzæ, Bacillus coli communis.

Among the spirilla the following are noted: Vibrio, cholera Asiatica, spirillum of relapsing fever, Spirocheta pallida (Treponema pallidum).

Bacterial Diseases.—Some of the diseases, the morbific agents of which have already been demonstrated, are the following: Septicemia and pyemia, pneumonia, gonorrhea, anthrax, malignant edema, tetanus, typhoid fever, tuberculosis, bubonic plague, diphtheria, influenza, cholera, relapsing fever, yellow fever, malaria, syphilis, etc.

Some of the diseases which are infectious, but the specific agents of which have not yet been absolutely demonstrated, are the following: Scarlet fever, measles, smallpox, rabies, pertussis, etc.

The pathogenic action of the morbific agents upon the body may be due partly to mechanical, partly biological and partly chemical action.

The very presence of the mobific agents may mechanically interfere with the physiological action of certain organs, causing stasis, hemorrhage, etc., or the increased activity of the morbific agents may cause local inflammation of tissues, infiltrations, and abscesses or the whole body may be infected by metastatic foci by means of blood or lymph, thus carrying infection to remote parts.

Much of the harm done is not by morbific agents themselves, but by their chemical products, or toxins which are the results of the bacterial action upon the blood and body fluids as well as to other bacterial products, endotoxins, proteins, etc.

These toxins are not as yet all known, and vary in their effects and virulence according to various factors.

2. **Portals of Entry.**—Infection of the body with microörganisms is by means of entrance of these organisms into the body through certain portals of entry which differ with each specific bacterium, so that some

bacteria may be entirely innocuous when entering a certain organ of the body, while pathogenic and virulent when entering another part or organ.

The principal ports of entry are the skin, the respiratory, the alimentary, and the genito-urinary tracts of the body.

While some microörganisms may enter the healthy and normal skin, this is very rare, and the commonest mode of entrance is through some solution of continuity, through cuts, bruises, abrasions, wounds, etc.

The skin as a port of entrance admits certain animal parasites, like favus, scabies, tinea, tonsurans; also through bites of insects in malaria, yellow fever, plague, through wounds, etc., in syphilis, septicemia, smallpox, etc.

The respiratory tract as the port of entrance admits, through the mucous membranes of the nose, eyes, ears, mouth, and throat, diphtheria, scarlatina, measles, influenza, pneumonia, etc. The throat, bronchi, trachea, larynx, and lungs may be the port of entrance of tuberculosis, diphtheria, pneumonia, influenza, pertussis, etc.

The alimentary canal as the port of entrance is open to typhoid, cholera, dysentery, etc.

The genito-urinary tract as the port of entrance is entered by gonorrhea, syphillis, chancroid, tuberculosis, diphtheria, septicemia, etc.

The different parts and tissues of the body react variously to microörganisms, while the various microorganisms have each a predilection for certain parts of the body, in some of which they thrive, while in others they succumb.

3. **Modes, Vehicles and Agents of Transmission of Infectious Organisms.**—The pathogenic bacteria are not found free in nature, but they live in the body, the blood, the secretions and excretions, the discharges of the body, the skin and the exterior of persons which they infect. Hence the principal agents of infection as well as vehicle of transmission, are man himself and animals, and their discharges.

The morbific agents are found in the various parts and discharges of the body. Thus, certain bacteria may be found on the skin, in the secretions of the eye, ear, nose and throat, the sputum, the expectoration, the perspiration of the skin, the urine, the solid excreta, the secretions from wounds and abscesses, etc. All the above-named secretions and excretions may contain virulent morbific agents which may be transmitted from one individual to another.

The transmission of bacteria may be direct, or indirect, by contact or by intermediary agents and vehicles.

Anything and anybody that may take up part of the secretions and excretions from an infected person and carry them to a non-infected person may serve as vehicle and agent of infection. Persons, animals, insects, food, milk, water, air, soil, and fomites may be then regarded as vehicles of infection.

The most frequent and demonstrated mode of infection is by direct contact of disease with the healthy, of the persons surrounding the infected ones, such as, physicians, nurses, etc.

Insects and animals may be the sources, the vehicles, and the intermediate hosts of infection.

Animal sources of infections are traced in glanders, anthrax, and other infectious animal diseases, in favus, scabies, etc., or through bited, as in rabies, plague, etc.

Animal vehicles of infection may serve in almost all infectious diseases, the morbific elements of which they may carry from diseased to healthy upon their bodies, or by means of parasites upon them, such as fleas, bugs, etc.

Insect sources of infection carry infective material upon their bodies, legs, and wings, and deposit the same infective materials upon the bodies of healthy persons, on their mucous membranes, on wounds, in the food, milk, water, etc.

It has been clearly demonstrated that insects—flies, fleas, lice, bugs, roaches, etc.—may and do transmit infective material from cholera, typhoid, tuberculous and other patients, and are capable of carrying infection to healthy persons, either indirectly to foodstuffs, directly by means of their bites.

That some insects, notably the mosquito, may become the intermediary hosts of several infectious diseases, has been demonstrated in the case of malaria, of yellow fever, and of elephantiasis.

In these diseases the infective parasite is sucked up from the blood of a human being by the mosquito, and within the body of the insect the infective agent undergoes further development, after which it may cause the disease when inoculated by the bite of the mosquito into a healthy person.

The spread of infection by food has also been demonstrated, and is an accepted fact.

Meat, milk, and other articles of food may become contaminated with infective material containing morbific agents, and such food and food products may upon ingestion by healthy persons cause certain infectious diseases. This is the case especially with those diseases the morbific agents of which have their port of entry in the digestive tract.

The germs of typhoid, cholera, dysentery, and probably tuberculosis are those which, if carried into the alimentary canal by various articles of food, may cause those diseases.

Infection may also be carried by fruit, vegetables, bread, milk, water, candy, and other food articles which are used without cooking, and which may carry infective material from the diseased to the healthy persons.

The soil as a source and vehicle of infection is claimed in plague, cholera, and other diseases, but its direct connection with diseases, except through the means of infected water, has not been directly demonstrated, except in hookworm disease.

Air as a vehicle of infection may serve through the medium of dust floating in the air, or through the droplets which are exhaled and expired by the tuberculous patients.

Infection by Fomites.—By fomites are understood various articles and substances in use by man which may carry infectious material and thus serve as vehicles of infection. Money, clothes, rags, bedding, underwear, books, mail, and the thousand and one other articles used by diseased persons, may be in use or handled by sick persons, may contain discharges from patients and may carry these from them to healthy individuals.

The importance of fomites has been greatly overestimated, owing to the misunderstanding of the exact nature of morbific agents and their activity, and it is at present claimed that fomites have nothing to do in the case of some diseases, while their importance in others has been also overrated.

PRINCIPLES AND PRACTICE OF PREVENTION.

Nearly one-third of all the deaths caused by all diseases is due to the diseases termed infectious or communicable.

The mortality statistics of the last census show that the death-rate from all causes per 100,000 population was 1588.5. The death-rate from only 11 of the infectious diseases was 425, as follows:

Tuberculosis of the lungs	154.7
Pneumonia	155.4
Diphtheria	27.7
Typhoid fever	23.3
Influenza	20.4
Scarlet fever	10.5
Whooping-cough	10.5
Measles	9.9
Dysentery	8.2
Malaria	4.0
Smallpox	1.3

If we add to these the 113.8 deaths due to diarrhea and enteritis, mostly infectious, the percentage of infectious diseases will exceed one-third of all the cases of death.

Infectious diseases may also be termed *preventable diseases*. In the progress of hygiene and public health there has been practically in all countries of the world a steady, regular and decided reduction in the mortality from infectious diseases. The last United States census has shown a decided lowering in the death-rate from all epidemic diseases. This is specially noted when the mortality for individual diseases is considered.

In the very short period between 1900 and 1909 the death-rate from tuberculosis of the lungs in 1909 is shown to have been only 73.6 per cent. of that in 1900. The death-rate from tuberculosis of the lungs in the United States Registration Area has been reduced from over 175 in 100,000 in 1900 to less than 125 in 1913. According to another table, the percentage of decrease in the death-rate from pulmonary tuberculosis in the period between 1890 and 1912 was not less than 48.9.

The percentage of decrease from typhoid fever has been shown to be 65.2 between the years of 1890 and 1912. Between the period of 1881 to 1915 the death-rate from typhoid fever in America has decreased from nearly 65 per 100,000 population to about 11. The decennial rate was 51.9 for the period from 1881 to 1890; 39 for the period of 1891 to 1900; and 29 for the period of 1901 to 1910.

The mortality-rate from diphtheria and croup has been reduced in the United States Registration Area in the period of 1900 to 1914 from over 40 per 100,000 to less than 20.

In certain countries, for instance, the cities of Denmark, the mortality-rate from diphtheria and croup has been reduced from 134 per 100,000 population in the pre-antitoxin period, to only 7.9 during the antitoxin period.

Perhaps no greater progress has ever been shown in progress of hygiene than is exemplified by the reduction in mortality of such preventable diseases as smallpox and yellow fever.

Smallpox has been reduced from one of the most deadly diseases to one of the most negligible. In certain countries, for instance, as in Prussia, it has been practically wiped out. In New York City there were only 2 cases of smallpox in 1916.

Since the discovery of the communication of yellow fever through the bite of an infected mosquito, this disease, which was so greatly dreaded in certain parts of the country, has become practically extinct.

Methods of Prophylaxis.—The methods of prevention of infectious communicable diseases may be divided into two groups, individual and social.

Individual Methods of Prophylaxis.—The methods of prevention which have the purpose to safeguard the individual from becoming a prey to infectious diseases may be grouped as follows:

1. Increasing the individual resistance and immunity.
2. Artificial immunity.
3. Destruction of morbific agents and carriers of infection.

Immunity.—Not all persons are equally susceptible to the action of morbific agents and their products.

The normal body, animal as well as human, possesses a certain natural immunity, or resistance, to the action of bacteria and their toxins. This vital resistance has been defined by Sedgwick as "that condition of the normal body, plant, or animal in which it is able to cope more or less successfully with unfavorable influences acting upon it from without, *i. e.*, from the environment."

Vital resistance against infectious diseases varies with each individual, in various places and with various times and under various conditions. It may be at times so low that the individual falls an easy prey to the first exposure to infection, or the resistance may be so complete against a certain infectious disease that no matter how great the number and how virulent the morbific agents, nor how favorable the conditions, the person remains unscathed, or "immune."

Immunity then is a state of relative or complete resistance of the constitution against specific disease.

Between extreme susceptibility and complete immunity there are many degrees of partial immunity, so that these terms "susceptibility" and "immunity" are relative rather than absolute. The immunity may differ according to time, to season, to place, to country, to race, to species, to family, to age, to individual health, etc.

To cite but a very few examples: White rats are completely immune against diphtheria; rabbits and guinea-pigs extremely susceptible. The white rat is immune against anthrax, the house rat is susceptible. Among races, negroes show great immunity to yellow fever and malaria, Japanese and Chinese to scarlet fever.

Besides natural immunity, there is also an acquired immunity; this is notably in persons who have recovered from certain infectious diseases. Familiar examples are smallpox, scarlet fever, yellow fever, also measles, typhoid, etc. Not all infectious diseases seem to give immunity to those recovering from them; thus persons recovering from influenza, pneumonia, and tuberculosis seem not only to become immune, but, indeed, are more susceptible than before. The immunity when gained may be complete for a whole life, or may last only for a more or less short time.

The degrees of vital resistance and immunity vary as already indicated, with many factors, and in individuals with the nutrition, metabolism, fatigue, conditions of health, etc.; and one or more of these conditions either increase or decrease the natural resistance, which is therefore spoken of as normal or physiological vital resistance, or increased physiological resistance, as differentiated from natural and from acquired immunity.

Aritficial Immunity.—Artificial immunity is divided into active and passive, according as to whether the immunity is developed within the body possessing it, or is transferred to it from other animals.

Active immunity is produced by the following conditions:

1. Recovery from disease.
2. Inoculation with virulent living bacteria.
3. Vaccination with attenuated bacteria.
4. With dead bacteria.
5. With bacterial extracts.

Passive immunity is conferred by antitoxins and serums.

Recovery from Disease.—Mention has already been made that recovery from certain infectious diseases confer a more or less permanent immunity. The immunity is equally conferred whether the disease is of a virulent type or is very mild, hence the exposure of healthy persons to a mild form of infectious disease may become beneficial by the immunity conferred by it against the more virulent types. As a matter of voluntary prophylaxis this form of immunity is not without its dangers.

Inoculation by Virulent Bacteria.—This is based upon the same principles as the immunity conferred by recovery from infectious disease, and has been used in the inoculation by variola. It has been employed also in cattle plague by inoculating the cattle with virulent bacteria, but under unfavorable conditions to the bacteria (in cattle plague into the tough tissues of the tail).

Vaccination by Attenuated Bacteria.—The bacteria are weakened and their virulence greatly diminished by subjecting them to unfavorable conditions, and then vaccinating the body by the modified, weakened, and attenuated virus.

The modification and weakening of the bacteria may be done by means of a previous growth in a body of a resistant animal, as in the case of vaccine virus, also chicken cholera. The modification may also be accomplished by drying, as in the case of rabies virus, or by means of heat, as in anthrax, or in Hafkin's first cholera serum; other unfavorable factors, such as electricity, light, chemicals, etc., may also be used to weaken the virulence of the bacteria.

Immunization by Dead Bacteria.—Instead of using for the vaccines living bacteria, dead bacteria are used, as in Hafkin's cholera, in Hafkin's plague, or in Koller's typhoid virus.

Immunization by Bacteria Products.—Finally, it was sought to produce artificial immunity by injecting into the body of bacterial products. This was used not so much for the purpose of immunization as for therapeutic purposes, as in the case of tuberculin (tuberculosis) and in plasmin (cholera, typhoid).

Passive Immunity.—While active immunity is produced by the persons themselves by means of the reaction of their body blood and fluid with living or dead bacteria and bacterial products, passive immunity is produced in an individual not by his own body but by the body of some other animal, which has been artificially immunized, and whose blood serum is injected into the human being to be passively immunized.

Thus if dead bacteria or bacterial toxins are injected into non-immune horses until the horses become highly immunized the serum of these immunized horses possesses certain antimicrobic and antitoxic properties, which act as antibacterials and antitoxins if injected into the human body.

The principal antitoxin serums used are those of diphtheria and of tetanus, the latter as a prophylactic measure, while the former as curative as well as prophylactic procedure. Antitoxins have also been made for cholera and for the plague.

Diphtheria antitoxin, which has played such an important role in the enormous reduction of the mortality from that disease, is at present prepared in a large number of laboratories, and it is very extensively used.

DISINFECTION.

Destruction of Morbific Agents and Carriers of Infection. —*Difficulties of Destruction.*—It is evident that the ideal means of prevention of infectious diseases would be the destruction of the morbific agents which have been found to be the cause of those diseases. The difficulties, however, which render this form of prophylaxis unattainable are (1) that the morbific agents of all infectious diseases are not as yet known; (2) that the known morbific agents are microscopic, invisible to the eye and cannot be found without special and expert knowledge; (3) that the microscopic causative agents of diseases are ubiquitous, and found everywhere, not only upon the sick persons, but also upon the healthy ones, in the air, in the dust, in the soil, water, food, milk, clothing, houses, indoors and outdoors, and everywhere, so that it is difficult to find a place where they are not present; and (4) finally, the morbific agents are not found free in nature but are in close contact with various matter to which they cling and it is the most difficult task to separate them and free them from their surroundings.

Where, however, the presence of morbific agents is suspected or ascertained it is not very difficult to destroy them.

Viability of Bacteria.—Not all bacteria and morbific agents possess the same viability; there are certain conditions, like mild heat, moisture, and nutrition, which are favorable to their growth and development, while other conditions, like too low or too high temperatures, dryness, absence of nutrition, and various physical and chemical agents, that are either inhibitive or destructive to the bacteria.

The destructive point of most bacteria differs according to the species, and this is also the case with effects of heat upon them.

Some bacteria succumb to comparatively mild degrees of heat (as, for instance, the spirillum of cholera at 125° F. for four minutes), while others resist a boiling-point a long time before being killed. This is especially the case with those bacteria which produce spores, notably the tetanus and anthrax bacilli.

The proper means of destruction of pathogenic bacteria will vary, therefore, according to the kind and species of microörganism, and also according to the medium in which it may be found, to the places where it may be lodged, and to many other factors.

Definition.—A definition of the various terms used in the inhibition and destruction of pathogenic germs will be of benefit.

Disinfection is the absolute destruction of pathogenic germs or the morbific agents.

A disinfectant is an agent capable of destroying pathogenic germs. A *germicide* is the same.

Sterilization is the absolute destruction of all organic life, whether infective or not; it is therefore more than disinfection which destroys the germs of infection only.

Antiseptics are agents capable of inhibiting pathogenic germs without totally destroying them; a disinfectant must be an antiseptic, but an antiseptic need not be a disinfectant.

Asepsis is the absence or exclusion of bacteria.

An *insecticide* is an agent capable of destroying insects; it is not necessarily a disinfectant, nor need a disinfectant be an insecticide.

A *deodorant* is a substance which neutralizes or destroys unpleasant odors; it is not a disinfectant.

Disinfectants are divided into three principal groups —physical, chemical, and gaseous.

Physical Disinfectants.—*Low Temperatures.*—Low temperatures are not regarded as disinfectants, as they do not destroy bacteria, but only inhibit their action and growth.

Sunlight.—Sunlight is a good disinfectant, provided the infective materials and the germs are directly exposed to the rays of the sun. The germ-destroying action of the light is thought to be due to the ultra-violet rays. Some germs are killed by a very short exposure to the direct rays of the sun. Tubercle bacilli are killed by direct sun rays within ten to twenty minutes, depending on the media in which they are located. Electric and other artificial light is said to have some germicidal action, but it is very slight in comparison to sun rays.

Desiccation.—Desiccation is like cold, an antiseptic but not a germicide. While bacteria must have moisture as a condition of their life and growth, desiccation will not always kill them; especially is this the case with the spore-bearing germs. *Koch* proved that the spore-bearing bacteria lose their viability after complete drying, but complete drying is very rare.

Heat.—Of the physical disinfectants, heat is the most valuable, the most reliable, and the one most commonly employed. Heat may be applied as a disinfectant in several modes: By burning, baking, boiling, and steaming.

Burning.—Burning is applicable only to materials and objects which are so greatly infected as to make any other destruction of infective agents difficult or impossible, or it may be applied to infected materials which are of so little value as not to pay for the expense of any other method. It is not always easy to destroy certain infected materials by burning. Some objects, like mattresses, etc., infected with cholera or typhoid excreta, require a very high degree of heat, possible only in special furnaces, for the total and absolute destruction of all germs, and unless the objects are totally consumed and turned to ashes the process cannot be regarded as complete.

Dry Heat.—Some spore-bearing bacteria are able to withstand very high degrees of dry heat (140° C.). This method is only applicable to objects that are not injured or destroyed by dry heat, such as metal and glass and like materials.

Boiling.—Most bacteria are killed at temperatures much below the boiling-point of water, and boiling for half an hour destroys most spore-bearing bacteria.

Boiling is therefore a very valuable and efficient as well as inexpensive method of destroying infective agents and materials. It is applicable to all objects which are not injured by the process, such as underwear, some kinds of clothing, textile fabrics, etc.

Steam.—This is the most valuable and efficient disinfecting method. Steam kills all bacteria at once, while the most resisting spores are destroyed within a very short period; steam is also very penetrating, and may be applied to a great many objects without injuring them. Steam may be applied in a small way in convenient Koch and Arnold sterilizers for domestic disinfection, and in a large way for large objects in institutions and hospitals by special apparatus.

Steam for disinfecting purposes is used in two forms—either as saturated streaming steam, or as superheated steam under pressure. While streaming steam may be sufficient for certain objects and infected materials, the penetrating qualities of superheated steam used under pressure, and the fact that such steam leaves disinfected objects dry, makes the latter method more valuable and efficient.

Streaming steam is used in the disinfection of objects by the Arnold disinfector as well as by the Koch apparatus. For disinfection by steam under pressure special apparatus, called autoclaves, are used.

Chemical Disinfectants.—Certain chemicals are capable of destroying pathogenic bacteria which come into contact with them.

These chemicals may be used in solid or liquid form or as gases. Their disinfectant qualities depend on the character of their chemical constituents, the form in which they are used, and the material in which the infective agents and germs are lodged.

The objections to chemical disinfectants are that most of them, to destroy infective agents, must be used in solutions so strong that they likewise injure the object to be disinfected; and, furthermore, that they must be thoroughly mixed with infected objects and come into direct contact with the infective germs, for otherwise their action is not destructive. It is exceedingly difficult to disinfect properly certain infected objects like cholera and typhoid discharges, unless the chemicals are very thoroughly mixed with every particle of the discharges; and this is very difficult.

Carbolic Acid.—This is a good antiseptic, but a comparatively weak germicide. Carbolic acid is not applicable to disinfection of material infected with spore-bearing bacteria, as its action upon spores is very feeble. It has been recorded that some anthrax spores can withstand a forty days' immersion in a 5 per cent. solution of carbolic acid (Rosenau). Non-spore-bearing bacteria are killed in a solution of carbolic acid of from 3 to 5 per cent. Carbolic acid has little penetrating power. It is largely used in solutions of 2 to 5 per cent., for washing floors, walls, wooden surfaces, small objects, etc. Its range of usefulness is wide, because it is not injurious to most objects.

Cresols.—Creoline and lysol are the most commonly used as disinfectants of this group, although others, like saprol, etc., may be employed. The cresols are more powerful disinfectants than carbolic acid, and are used for about the same objects.

Corrosive Sublimate.—Bichloride of mercury is a valuable disinfectant, and is used in solutions of from 1 to 2000, to 1 to 500. In the stronger solutions it kills germs rapidly, but because it unites and forms insoluble compounds with albuminous matter, corrosive sublimate loses much of its disinfecting property when used for infective agents mixed with much organic matter. According to Rosenau, corrosive sublimate kills spores in solutions of 1 to 500 after exposure for one hour; solutions of 1 to 1000 destroy non-spore-bearing bacteria within a half-hour at ordinary temperatures. As an antiseptic, corrosive sublimate is used in medical and surgical practice in solutions of 1 to 2000 to 1 to 10,000.

Lime.—In the form of chlorinated lime, or of Labarraque's solution, it is a good disinfectant for excreta, and is used for disinfecting privy vaults, cesspools, cellars, etc. It is efficient only when it is freshly prepared.

A number of other chemicals are used as disinfectants, although their range of usefulness is limited and they are not commonly so employed. Of these chemicals, mention may be made of potassium permanganate, ferrous sulphate, zinc chloride, copper sulphate, borax, boracic acid, and a number of others.

Gaseous Disinfectants.—Gaseous disinfectants are more valuable than other disinfectants, because of their penetrating power and the possibility of reaching surfaces and places which are inaccessible to ordinary liquid chemicals. Of the gaseous disinfectants employed, the most important one is formaldehyde, which has lately superseded the once very popular sulphur dioxide disinfection. Among the other gaseous disinfectants sometimes used are chlorine, bromine, and hydrocyanic acid, but these have been discarded almost entirely because of their toxic nature and their questionable effects on bacteria.

Sulphur Dioxide.—Sulphur dioxide is a powerful germicide and a good surface disinfectant; its disadvantages are (1) that it is not very penetrating, (2) that it does not destroy spore-bearing bacteria, (3) that it damages textile fabrics, (4) that it bleaches vegetable colors, and (5) that it injures and tarnishes metals. It is also poisonous to those handling it, causes injury to the mucous membranes of the eyes, nose and throat, and leaves a very disagreeable odor clinging to materials for a long time.

Several *methods of sulphur disinfection* are employed. The pot, candle, or liquid form, also the furnace. About five pounds of sulphur are used for every 1000 cubic feet of space to be disinfected. Moisture and heat increase the penetrating qualities of the gas and the value of disinfection. An exposure of twenty-four hours is necessary for thorough disinfection, and as the gas is very diffusible, precautions must be taken effectively to close all windows, doors, cracks, crevices, and other apertures found in the room.

Sulphur disinfection is preferable wherever surface disinfection is needed and where there are few articles which would be damaged by it, also wherever insecticide action is demanded.

Formaldehyde Gas.—Formaldehyde gas has very largely superseded sulphur dioxide as a disinfectant. Its main value is that while it is a good germicide it does not destroy fabrics and injure objects, and also that it is non-toxic. Formaldehyde also is only a surface disinfectant, and its penetrating qualities are not very great. Bacteria are killed immediately by formaldehyde on direct exposure, and spores within an hour. It kills dried organisms as well as those in a moist state. Formaldehyde is not an insecticide.

For domestic disinfection formaldehyde is generated by spraying liquid formalin (which contains 40 per cent. of the gas) or by heating paraform pastils or powder, also by means of generators or lamps. Other methods of evolving formaldehyde in disinfection which are used in large house and hospital disinfections are by means of large generators or lamps, or in specially constructed autoclaves under pressure, or in retorts without pressure.

Disinfection of Rooms, etc.—Practical disinfection is a process which needs scientific precision and attention to details. It must be adjusted to the form and nature of infection and the infected materials and objects, each of which may need a different method of handling and disinfection. The disinfection of rooms and infected materials differs according to the disease; various methods must be employed after tuberculosis, typhoid fever, yellow fever, diphtheria, scarlet fever, etc.

Room Air.—The *room air* needs no disinfection, for whatever germs may be found in the dust of the air in a room will settle upon the surfaces whenever the room is closed and left undisturbed.

Room Walls.—The room walls if covered with paper may be efficiently disinfected by thorough rubbing with stale bread. Painted surfaces of walls and ceilings may be disinfected by washing with 3 per cent. solution of carbolic acid or a 1 to 500 solution of sublimate of mercury. Floors and other surfaces of rooms may also be conveniently scrubbed with hot water and a solution of carbolic acid or sublimate, or one of the cresols. Carpets, rugs, etc., may be efficiently disinfected by a strong solution of formalin, by gaseous disinfection with formaldehyde, or steam under pressure. Curtains, hangings, etc., within the rooms are disinfected with formaldehyde, and may also be washed in boiling water. Wooden bedsteads may be washed with a 3 per cent. carbolic solution or a 5 per cent. formalin solution. Bedding, linen, etc., may be disinfected by steam, by formalin, and also by formaldehyde.

For the successful disinfection of rooms with a gas it is necessary to close all openings, cracks, and crevices, keyholes, etc., completely, and especially the crevices about windows and doors. This is done by means of cotton, or better, by means of gummed paper strips. Raising the temperature of the room assists disinfection. The room is then closed and all openings and crevices are sealed with gummed paper, and the room is left for at least twenty-four hours.

Excreta, sputum, feces, and other discharges of infected persons must be gathered and collected in special glass or porcelain vessels and disinfected by means of the various chemical disinfectants like lime, cresols, carbolic acid, copper sulphate, and formalin. Whatever disinfectant is used it must be thoroughly mixed with the discharges so as to penetrate them through and through, and it must also be used in large quantities and in very strong solution.

Feces.—Feces are disinfected by carbolic acid, 5 per cent.; solution of chloride of lime, 5 per cent.; formalin, 10 per cent; or by boiling.

Thermometers.—Formalin, 40 per cent., absolute alcohol.

Soiled Wash.—Soiled wash, according to Rosenau, is to be disinfected as follows:

"It is wrapped in a sheet wet with sublimate solution, and this placed in a sack likewise moistened with a germicidal liquid. The sack is placed unopened in a solution containing 3 per cent. of soft soap and heated to 50° C. for three hours and left in the same solution forty-eight hours after it cools. If not soiled with albuminous matter the wash may be immersed in a solution of bichloride of mercury, 1 to 1000, with the addition of common salt. After this preliminary disinfection the articles are boiled half an hour in a water containing:

Petroleum	10 grams.
Soft soap	250 grams.
Water	30 liters.

The Practice of the New York City Department of Health in Regard to Disinfection after Infectious Diseases.—Within the last year or two the New York City Department of Health has adopted radical views in regard to disinfection after infectious diseases. The following excerpts from the *Year-book of the Bureau of Preventable Diseases* (1916) give the details of the disinfection procedure of the department, with special regard to the nurses' work.

Discontinuance of Fumigation.—Premises occupied by persons suffering from infectious diseases were formerly fumigated with formaldehyde by the Department of Health, and bedding removed for steam sterilization.

From its experience, the department has concluded that routine fumigation as a means of disinfection of premises where cases of infectious disease have occurred can be dispensed with as ineffective and unnecessary. It is ineffective in that, as usually performed, it does not destroy the disease germs. It is unnecessary for the reason that in recovered cases all contagion has disappeared from the premises by the time the patient has recovered.

The discontinuance of fumigation on October 8, 1914, in the boroughs of the Bronx, Queens, and Richmond, as a routine method of disinfection after the major acute infectious diseases, was not followed by any increased prevalence of diphtheria, scarlet fever, or measles. On January 1, 1915, such fumigation was also discontinued in the borough of Manhattan, but continued in the borough of Brooklyn, for purposes of control, and in order to test the efficiency and value of fumigation until August, 1915, when it was discontinued there also, there being no decreased prevalence of scarlet fever, and diphtheria in that borough as compared with the others.

It should be understood that in discontinuing fumigation the Department of Health has laid increased stress upon other and more efficient methods of disinfection, namely, thorough cleaning, fresh air, and sunlight, and particularly renovation (*i. e.*, repainting and repapering), when necessary. Prior to the discontinuance of fumigation no such renovations were enforced in any of the infectious diseases except tuberculosis. During the first five months of 1915, 10,785 such renovations, in addition to those for tuberculosis, were ordered and carried out.

That the Department of Health was justified in its action is shown by the fact that there has been no increase in the prevalence of the various diseases; better and more efficient disinfection has been performed, and the saving to the city has been at the rate of about $30,000 a year.

General Disinfection Procedure.—In diphtheria and measles when patient recovers the sick-room is thoroughly cleaned and aired. The woodwork and floors of the room are scrubbed with solution of one pound of washing soda to three gallons of hot water. Recommendation is made that nightgowns, sheets, etc., be first soaked in carbolic solution and then boiled in soapsuds for one-half hour. Destruction of books and toys used by patient is recommended.

In cases of smallpox, typhus, cholera, plague, and yellow fever, bedding is removed for steam disinfection. Otherwise there is no removal of bedding except upon request of the attending physician.

In cases of poliomyelitis and cerebrospinal meningitis recovering at home there is no fumigation or removal of goods, but renovation may be required. In fatal cases or removal cases, fumigation is ordered.

In mumps, German measles, whooping-cough and chicken-pox neither fumigation nor removal of goods is performed.

In tuberculosis renovation of the premises is done, following death or removal to other address. There is no removal of bedding except by special request or when unusual circumstances connected with the case require that such action be taken.

In typhoid fever disinfection is not ordered except upon special request, unless the circumstances of the case demand it.

In making use of the various methods of disinfection the availability of each, and their inherent limitations, should be kept constantly in view, as, for example, the fact that liquid disinfectants are only effective when the circumstances permit of their systematic application to all the surfaces to be treated, and that gaseous disinfectants are only of use for surface disinfection.

The fact is strongly insisted upon that for floors, woodwork, and similar surfaces, soap, hot water, and a scrubbing brush, thoroughly used, are of greater efficiency than either liquid or gaseous disinfectants, as the latter are usually employed; that boiling is the best method for treating all fabrics or articles not injured by such treatment, and that full aëration and exposure to sunlight must be regarded as of primary importance in all cases.

Inspector and nurses constantly repeat the injunction that all articles used about the patient should be boiled or otherwise disinfected as often as used; that all discharges from the nose, mouth, bladder, and bowels must be immediately disinfected or destroyed; and that these things, assisted by scrubbing, sunning, and airing of the sick-room, and by personal cleanliness and frequent hand-washing by the attendants, greatly lessen the danger of the disease being communicated to others.

Liquid Disinfectants and Uses.—1. For all body discharges: Freshly made chloride of lime, 5 per cent. carbolic acid solution, or 2 per cent. lysol solution.

2. Woodwork and floors should be scrubbed with solution of 1 pound of washing soda to 3 gallons of hot water.

3. Bed and personal linen should be immersed in boiling water for five minutes, or in 5 per cent. carbolic solution for one hour, the articles to be completely submerged.

4. For washing of floors, bedsteads, and other surfaces: Soap and hot water applied with scrubbing brush, or when fouling by sputum or other discharges has occurred, the saturation of deposited matter with carbolic solution (5 per cent.) or lysol solution (2 per cent.), and after thirty minutes wiping up with rags or other articles that can be boiled or burned.

Kinds of Disinfection Ordered.—According to the conditions of the premises the nurse may recommend: (1) That nothing be done; this is most exceptional, obtaining only in very recently renovated apartments and those where the patient only spent one or two nights on the premises; (2) that a thorough cleansing and airing is sufficient when the premises are in good condition; (3) that the patient's room be thoroughly renovated; the walls washed and recalsomined, repapered or repainted, and the woodwork and floors be washed and repainted; (4) that the whole apartment be renovated.

Scrubbing Floors and Woodwork.—In all instances in which this is the only procedure recommended by the nurse, she makes every effort to induce the janitor to perform the work voluntarily without the issuance of a notice. Should she fail to obtain this result, she forwards a report on the regular renovation blank making a report and recommendation in a manner exactly similar to a case in which a notice should be issued, except that after the recommendation the following statement is made: "Inasmuch as I have been unable to obtain voluntary compliance with this recommendation, I would further recommend that the scrubbing of floors and woodwork be enforced by the sanitary police."

SOCIAL MEASURES OF PROPHYLAXIS.

The prevention of infectious diseases must largely be based on social measures and public defensive methods. Of these defensive methods the following are of special importance: (1) Notification and registration of infectious diseases; (2) isolation and quarantine of infected persons; (3) hospital treatment and care; (4) general sanitary measures.

In order that the sanitary authorities should be able to cope with infectious disease they must first know of its existence, hence the provisions in all sanitary codes for compulsory notification and report of infectious diseases. The duty of reporting lies primarily upon the physician treating these cases and also upon any other person coming in contact with them and having knowledge of the diseases.

The list of diseases for which compulsory notification is at present demanded includes the following: typhoid, typhus, variola and varioloid, scarlet fever, measles, diphtheria, miliary fever, cholera and choleriform diseases, ague, yellow fever, dysentery, puerperal infection and ophthalmia of the newborn (unless the confinement is not made public), epidemic cerebrospinal meningitis, and acute anterior poliomylitis. All cases which are reported to the health departments are carefully registered and a record kept, the system of registration for all infectious diseases being uniform.

In all congested communities it is important that persons suffering from certain infectious diseases should be completely isolated from those who are well. Such isolation of infected persons should be voluntary wherever the population is educated and is progressive. As a rule, however, it is compulsory in view of the general ignorance as yet prevailing among the population.

The isolation may be of the patient himself, of the room where he lies, or of the apartment or house in which he lives, as well as of the family surrounding him. The degree of isolation depends much on the disease and the intelligence of those who surround the patient. Where isolation is absolutely necessary but for some reasons cannot very well be obtained, as for instance, in virulent cases of smallpox in crowded tenement houses, there may be ordered the compulsory removal of the patient to a hospital. The sanitary authorities of the community prescribe the exact form of isolation, order the needed quarantine of the room or house, place the necessary placards, and perform such other preventive acts as are deemed good for the public health.

The duration of isolation of the patient, etc., depends on the disease, and may last but a few days in a case of diphtheria to a few months in a case of scarlet fever.

The treatment of infectious disease is either private or in hospital. There is no doubt that for the public good and for the thorough eradication of infectious diseases, hospital treatment of all cases of infectious diseases would be preferable, as best tending to help not only the patient but to prevent the spreading of the disease in the community; but there are still many objections against compulsory hospital treatment of all infectious diseases as a summary measure, and it must be limited but to certain few diseases and to the poorest part of population.

Sanitary Measure.—Certain public measures are necessary for the prevention of the spread of infectious diseases. These measures consist in the control of public food, milk and water supplies, in the prevention of infections in schools, factories, by means of transportation, by commerce, maritime vessels, interment, etc. The public prophylactic measures adopted to lessen and limit infectious diseases by means of public water, food, and milk supplies have already been discussed in some detail in the chapters on those subjects.

The school as a source and field of spread of infectious diseases has also been spoken of, and the modern methods of prevention mentioned as consisting in a thorough system of medical school supervision. During epidemics it has been found necessary to close schools for certain periods.

No less a prominent factor in spreading infection is found in the factory and industrial establishments, and prophylactic measures are required to limit communication of disease in industries. The best method of prevention would be proper medical supservision and control of all industrial establishments, with initial medical examination of employees, also periodical examination of all persons in employment and isolation of infected ones.

The supervision of commerce, transportation, means of transit by railroads and steamships is also necessary for prevention of the spread of infectious diseases. The measures adopted for this purpose are the supervision and inspection of railroads and steamships, quarantine between cities, States, and countries in times of epidemics, the inspection and disinfection of vehicles, cars, baggage, etc.

Measures for supervision of the interment of persons dead from infectious diseases consist in the disinfection of bodies, and of the means of transportation, and the provisions against public funerals in cases of communicable diseases.

INFECTIOUS DISEASES: THE ROLE AND FUNCTIONS OF THE NURSE IN THEIR PREVENTION.

Public-health nursing in general and in infectious diseases especially is of comparatively recent origin. Scarcely fifteen years have passed since the New York City Department of Health engaged the first nurses to care for cases of diphtheria, scarlet fever, and measles, and during the next year engaged the first nurse for tuberculosis work. Visiting nursing was in its infancy in the beginning of the twentieth century. It is in full swing at present, only a decade and a half since its inception. In 1902 there were only 136 visiting nurses in the country; in 1916 the number was over 5000. The nurse has become the mainstay of prophylaxis in infectious diseases as well as in others. Public health nursing has become a profession. There is hardly a city department having to do with sanitation and health that does not employ a large and ever-increasing number of trained nurses. This is but the beginning. There is no doubt that the influence of the public health nurse will be more and more extended and ever increase in the extent of its usefulness.

The functions of the public-health nurse in infectious diseases are manifold and varied. They may be summarized as follows: Visits to persons suffering from infectious diseases; discovery of new cases; care of the sick at home or at the hospital; investigation of family, economic, and other conditions of the sick and those nearest to him; instruction to those who care for the infected person as to how to take care of the various discharges and other agents of communication of the disease; the education of the family in the proper care and in methods of prophylaxis; the education of the patient and his caretakers in the after-treatment during convalescence; assistance in the dispensaries, clinics, and hospitals in the care of ambulant and other patients; the placarding of the rooms and homes of infected persons; supervision of the observances of isolation and quarantine; orders for terminating cases and for disinfection.

The following practice of the New York City Health Department gives a brief review of the duties of nurses in infectious diseases:[1]

"*District Nurses.*—The district nurses supervise at their homes cases of tuberculosis, scarlet fever, diphtheria, cerebrospinal meningitis, acute poliomyelitis, whooping-cough, and typhoid fever. They are also on duty in the tuberculosis clinics, where they receive patients and prepare them for physical examination by the physician; take their temperature, pulse,

[1] The Year-book of the Bureau of Preventable Diseases, Department of Health, New York City, 1916.

respiration, weight, and height; distribute circulars of information in the patient's own language and issue instructions as to necessary sanitary precautions to be observed.

"*Nurse's Outfit.*—When on duty in her district every nurse carries with her the following outfit:

"Clinical thermometer; watch with second hand; fountain pen; history cards; cards for referring patients to clinic; circulars and hanging cards for information regarding infectious and contagious diseases; sputum bags and paper napkins; blue clinic information cards; sputum bottles; notification postal cards; certificates of infectious disease; school exclusion and readmission cards; rules, Bureau of Preventable Diseases.

"*General Duties of District Nurses.*—At the first visit to a case of infectious disease the district nurse locates the janitor and inquires if anyone in the building is ill with any infectious disease and without a physician in attendance.

"On arrival at apartment of patient she inspects quarantine, obtains necessary data for the history card, and informs family that teachers and pupils must not attend any schools. She determines whether case required observation or supervision, and ascertains what members of the family have had the disease.

"She delivers a hanging card of detailed instructions relating to the case. She post placards and takes cultures from the patient and other members of the household when requested.

"On revisits she determines if quarantine is observed and ascertains if secondary cases have appeared in the family.

"At the final visit she terminates the case, orders disinfection, and issues school certificates.

"Nurses make all visits to cases of infectious diseases except those for diagnosis and the first visit to cases of cerebrospinal meningitis.

"Upon arrival at the case the physician or nurse fills out a history card, inspects arrangements for isolation, excludes susceptible children or teachers, gives verbal instructions, and leaves a hanging card of general information about the disease. This card particularly emphasizes the manner in which the disease is spread and the steps necessary for its efficient isolation. Cases are visited sufficiently often to maintain proper quarantine, and are classified, according to the ability of the family to appreciate and maintain satisfactory isolation, into:

"Supervision cases, which require visits every day or every few days, and,

"Observation cases, which require only occasional visits.

"*Occupations.*—The occupations of other members of the family are investigated with reference to the character of their work. The dangers of spreading disease may be greatly increased because of the nature of the work done in the home, or because of the character of the employment of members of the family outside the home. Members of the family are forbidden to continue such home occupations as tailoring, dressmaking, feathermaking, etc., or to engage in any way in the handling of foodstuffs.

"*Placarding.*—Cases of diphtheria and scarlet fever occurring in tenement houses, furnished rooms and boarding-houses, and two-family houses with common entrance, are placarded. The placard in tenement houses is placed on the door of entrance from the public hall; in furnished-room houses, boarding-houses, etc., on the door of the sick-room, and in the two-family houses with common entrance upon the door leading from the common hall to the infected apartment."

Nursing in Tuberculosis.—For the purposes of supervision of all persons suffering from tuberculosis, the Health Department divides these cases into several classes:

Class 1. Cases under the care of private physicians.

Class 2. Cases reported in tuberculosis clinics.

Class 3. Cases admitted to hospital.

Class 4. Cases leaving the city temporarily or entering sanatoria.

Class 5. At home cases.

Class 6. Dead cases and recovered.

Class 7. Tuberculous school children.

As far as the cases under the care of private physicians are concerned, the function of the nurse is limited to finding out whether the patients live at the address given and the character of the house in which they live.

Cases which are reported by clinics are visited by the nurse, who investigates the housing conditions and seeks to find out all information about the patient and his surroundings. The nurse also takes care to induce the patient to visit the clinics regularly and to order disinfection if necessary.

Cases which are found as unable to take care of themselves may be recommended by the nurse for forcible removal to a hospital. This can be only done on the ground that the patient is a menace to the health of others. It is best for the nurse to obtain the patient's consent to enter a hospital. The grounds for the forcible removal to a hospital of a case of tuberculosis are, according to the New York City Health Department, the following: "(*a*) That the patient's sputum contains tubercle bacilli; (*b*) that the patient either will not or cannot observe the necessary precautions as to the disposal of sputum; and (*c*) that others, especially children, are exposed to infection." Cases admitted to a hospital are given to district nurses to be investigated as to their social and financial conditions.

The district nurse is especially valuable in the "at home" cases. Here there is much scope for the work of the nurse, for her educational work, and for the supervision of general sanitary conditions of the patient and his surroundings. The patient should be visited at least once a week and the nurse come in close and friendly contact with the patient and his family. The nurse, in her visits to the patient's home, must also be ever on the lookout for new cases of tuberculosis among the family and neighbors.

Special care must be taken in isolating the patient from children and with the care of children in their school and outside. Sickly or anemic children in the home where there is a case of tuberculosis must be attended to and, if possible, sent to open-air schools, day camps, or preventoria.

DIPHTHERIA, SCARLET FEVER, AND MEASLES.

"**Diphtheria.**[1]—The incubation period of diphtheria is from one to five days; the quarantine period is twelve

[1] From the Year-book of Preventable Diseases, Department of Health, New York City, 1916.

days from the onset of the disease, during which time no later cultures are examined. Thereafter the quarantine period lasts until two successive negative cultures, preferably from both nose and throat, have been received.

"If the diagnosis depends upon a culture alone and the culture is negative the case is not considered as one of diphtheria; cases reported by postal cards are considered as diphtheria, unless otherwise requested, even though cultures are negative.

"A district nurse sees each case of diphtheria on the day it is referred to her. Upon her first visit, upon request of the attending physician, she takes a culture from the patient's nose or throat, unless this has already been done by the district diagnostician. Trial cultures are made from all members of the family by the private physician or by the district nurse, with his consent, in order that carriers may be immunized against the disease.

"If quarantine is observed or address changed, children or teachers who have been immunized and cultures from whose nose and throat are negative may return to school. If not immunized and no negative cultures have been obtained, even though the address be changed, school permits are not issued for seven days. If they remain at original address until case is terminated, school permits are not given until seven days after the latest case in the family has been terminated by the Department of Health.

"*Termination of Cases of Diphtheria.*—No case is terminated until at least twelve days have elapsed from the beginning of the illness, and two successive cultures, preferably from both nose and throat, taken not less than twenty-four hours apart, do not show the presence of diphtheria bacilli.

"**Scarlet Fever.**—Incubation period two to five days. Quarantine period thirty days, provided desquamation is complete and discharges from nose and ears have ceased.

"The virus of scarlet fever is contained in discharges from mouth, throat, and nose; possibly also in discharges from open sores. It is most abundant during the period of eruption, but may persist for a long time. During or even after convalescence it may undoubtedly be given off from mucous membranes when no abnormal condition whatever is discoverable. This virus may be transmitted from one person to another, either directly, as by coughing, sneezing, kissing, or other actual contact, or indirectly by articles which have been in contact with the discharges just mentioned and are still infected by them.

"How long, after contamination, fomites remain dangerous is not known with exactness, as the germ of scarlet fever has not been isolated. There is reason to believe that this germ is longer lived than the germ of diphtheria or of measles or of whooping-cough, and is more resistant than they are to heat, cold, sunshine, or moisture. The desquamation of scarlet fever is not believed to be an infective agent unless contaminated by secretions. The tendency is to concentrate our efforts on the patient and to regard the onset period as by far the most important.

"When the requirement for satisfactory quarantine at home cannot possibly be carried out, every effort is made, with the assistance of the private physician and the consent of the family, to secure the removal of the patient to a hospital. There are very few 'forced-in' cases. The people of the city are acquiring a better appreciation of the excellent service given them by the hospitals of the Department of Health.

"When shall quarantine be lifted? Cases undoubtedly differ in the persistence of their infectivity. The best way seems to be to fix a minimum period applicable to all cases, and to prolong this when the case demands it. At the present time thirty days is the minimum. Many suspects, where the evidence is insufficient or otherwise unsatisfactory, are held for shorter periods and with varying restrictions.

"One great hindrance to effective work against the spread of scarlet fever is the difficulty of making a diagnosis in many mild cases. The character of the onset of scarlet fever is the most variable of any of the exanthemata. The symptoms may be so trivial that the patient does not suspect the nature of the indisposition; no physician is called. Many people, after exposure to scarlet fever, suffer from a sore throat, nothing else. A positive diagnosis here is impossible. Many people have a life-long immunity to scarlet fever; many are immune at one time and susceptible weeks, months, or years later. It is reasonable, therefore, to suppose that there may be surface invasion of mucous membranes by this germ for wholly indeterminable periods without the production of any local or general infection.

"It is well to bear in mind that the immunity acquired from an attack of scarlet fever is not invariably permanent. One meets, from time to time, cases of perfectly characteristic scarlet fever which give indisputable evidence of a previous attack. Such cases are rare, and there is, of course, always a chance for error. One should be particularly suspicious of the accuracy of either the present or the former diagnosis when the interval between the two attacks is less than five years."

Instructions to Nurses as to Their Duties in the Care of Measles, Scarlet Fever, and Diphtheria.[1]—Upon entering the home, remove hat and coat and place together with the bag in a room farthest from patient's. Remove from bag, cap, gown, rubber gloves, and all other articles needed, such as cotton, gauze, etc. Dress in cap and gown. Clear patient's room as much as possible of all unnecessary articles. Collect and mark with adhesive the necessary utensils for patient; these are to be kept in patient's room. Prepare solutions for cleansing eyes and mouth and for irrigating nose and throat (if this treatment is ordered).

Give treatment, disinfect thermometer by placing in pure carbolic then in alcohol. Bed and body linen should be soaked in chloride of lime solution ($\frac{1}{4}$ pound to the gallon) for a couple of hours before being washed.

If possible, rags should be used for nasal and throat discharges, they should be placed in paper bags and burned. The nurse should instruct member of family who is to care for patient about disinfecting hands in

[1] The instructions as to the duties of the nurse in contagious diseases are taken from the practice of the Henry Street Nurses' Settlement, New York City.

lysol solution after doing anything for patient, about general hygiene, isolation, ventilation, diet, etc.

When finished, nurse is to remove cap and gown, place in paper bag, and leave in patient's room; soak hands well in lysol solution, then wash well with green soap and running water.

At end of day, nurse's bag is opened and placed in a fumigating cabinet, a towel saturated in formaldehyde is hung in cabinet, cabinet sealed, and bag removed the next morning.

When case is dismissed, instruct family to boil patient's dishes well, put bedding out of doors in the sunshine, and disinfect room (bed, walls, furniture, etc.); this can be done very thoroughly by scrubbing well with soap and water.

Pneumonia Case.—Orders: General care; saline rectal irrigation; mustard plaster to entire chest until skin reacts; alcohol sponging; mustard foot bath; cold compress around chest.

Place paper napkin on table and get out all the necessary things from bag. Alcohol (for cleansing thermometer); green soap (for washing hands); vaseline (to lubricate thermometer and rectal tube); boric acid (for mouth wash); rectal tubes; tooth-picks; scissors; cotton; mustard; old piece of cloth to make mustard plaster; small piece of cloth or gauze to make mustard bag for foot bath; glass connecting tube; douch bag; toilet soap; towel; wash cloth; pan for return of irrigation; clean clothes for patient and for bed; rectal thermometer; safety-pins; a piece of oilcloth or oiled silk to cover compress on chest; wash basin; small bowl or dish for the alcohol sponge; paper bag for waste material; glass and teaspoon to prepare mouth wash; comb.

Prepare mustard plaster and place on a warm platter or plate to warm; prepare mustard bag for foot bath (1 tablespoonful of mustard to 1 quart of water; for plaster, 1 to 6 unless otherwise instructed); prepare saline solution for irrigation, using 1 teaspoonful of salt to 1 pint of water; hang bag in a convenient place near patient; prepare boric solution for mouth; if patient is a child, prepare tooth-pick swab for cleansing nose.

Protect bed (or pillow on table) with oilcloth; take "T. P. R." and record in note-book; place mustard plaster around chest; hold in place by a towel fastened in front with safety-pins; bring buttocks to edge of bed or pillow; with patient lying on left side, give saline irrigation, having someone hold pan to catch return; wash rectal tube and put on to boil; if patient is a child, protect with a diaper in case there should be further return; remove mustard plaster if skin is reddened; wash mouth, cleanse nose, give bath, comb hair, apply cold compress around chest, protecting with a piece of oilcloth or oiled silk, held in place by covering with a small towel or diaper and fastening in front with safety-pins; put on gown, make bed, give mustard foot bath, using friction; apply warm bottle to feet and ice-cap to head. Instruct family about changing compress, giving medication and nourishment, keeping window open, etc. In P.M. same treatment is given, giving an alcohol sponge instead of the cleansing bath.

Typhoid Case.—*Orders.*—General care, cleanse mouth, alcohol sponging, enema, typhoid precautions.

Clear the room as much as possible of all unnecessary articles. Prepare a solution of chloride of lime in a large pail, basin, wash-boiler, or wash-tub by placing chloride of lime ($\frac{1}{4}$ pound to 1 gallon of water) in four thicknesses of gauze and dissolve in the pan of water. Prepare a solution for the hands, lysol 2 per cent. (1 teaspoonful to 1 quart of water). Collect the necessary dishes and mark with adhesive; prepare solution for cleansing mouth (boric, listerine, etc.) if tongue is furred; prepare a solution of equal parts of lemon juice and glycerin. Have family provide their own vaseline for thermometer, rubber catheter, or enema tip, alcohol, toilet paper, etc. (if possible).

Typhoid thermometer should be marked and kept separate.

Typhoid apron or gown should be marked by pinning a safety-pin on the side of the apron which is turned toward the patient. This side should be folded in and the apron placed in a paper bag and left on bedside table when nurse has finished giving care. When apron is soiled, place it in the chloride of lime solution with the other clothes; have family wash and iron it for next visit; this should be done also at close of case, so that apron may be returned to office properly disinfected.

Take out only the necessary articles from the bag, place on paper napkin; thermometer, alcohol, cotton gauze (for chloride of lime), lysol, vaseline, paper bags, paper napkins, adhesive, wooden spatulas (to split and wind with cotton to apply glycerin and lemon juice to tongue), bedside notes, etc. Prepare solutions, mark utensils, prepare enema; have some member of family bring necessary articles to work with (bed-pan, basin, for bath, comb, soap, clean linen, etc.). Take temperature, pulse, and respirations. See that bed is protected with rubber or oilcloth; give enema; give bath (be careful about abdomen); alcohol rub if necessary; cleanse mouth and tongue; comb hair; make bed (always have bed protected by rubber and draw sheet). As nurse removes clothing from patient or bed it should be placed in the chloride of lime solution to remain for two hours, then washed and boiled. When patient is removed from bed-pan, sprinkle freely contents of bed-pan with chloride of lime, making sure that there is always enough moisture in vessel to dissolve lime, and allow to remain standing at least a half-hour before emptying. Prepare bedside table; leave paper bag and toilet paper for patient to use for expectoration; write up bedside notes; remove apron and fold and put in paper bag; soak hands well in lysol solution; wash hands and place articles back in bag. Instruct family about typhoid precautions (if possible do not permit person who does the cooking to take care of the patient), diet, ventilation, etc.

P.M. visit; "T. P. R." Wash face and hands; alcohol sponge or alcohol rub; cleanse mouth; arrange bed.

Bath water may be placed on stove and boiled up before emptying.

Solutions for clothes and hands should be changed twice a day if necessary.

Erysipelas.—Erysipelas cases are to be visited after all other patients have been seen for the day.

A pasteboard box containing all necessary articles for the patient is to be taken to the home and left in the patient's room. Nurse's bag is not to be taken into patient's room. Rubber gloves and a gown (with pin attached to side worn toward patient) to be left in patient's room.

Nurse's coat, hat, and bag to be left in a room farthest from patient's. After nurse has removed her hat and coat, take from bag, lysol, green soap, and brush. Prepare a 2 per cent. lysol solution (1 teaspoonful to 1 quart of water) for hands.

After nurse has given the necessary care, she is to soak her hands well in the lysol solution, wash hands and put things back in bag.

CHAPTER VII.

PERSONAL HYGIENE.

PERSONAL hygiene is the science and the art of the preservation and the promotion of individual health and life. Its purpose is the prevention of constitutional diseases and the increase of the vital force of resistance of the human body.

The causes of constitutional diseases depend less upon the environment of the individual, and more upon his personal modes of living, habits, and conformance with the laws of nature and rules of health. To combat infectious diseases we must improve environmental conditions common to many persons and communities and promote public health by municipal, social, and public health measures. To combat constitutional diseases we must depend on vital force and resistance of the human body upon the following by each individual of the proper rules of hygiene and the avoidance of anything that may be injurious to life or detrimental to health.

Although giant strides have been made in the progress of prevention of infectious diseases, very little comparatively has been done to promote individual health and to prevent the incidence of constitutional disease. Indeed, while we have succeeded in very materially reducing the mortality and morbidity from infectious diseases and in increasing the length of life, there has been unfortunately an increase in mortality of the middle-aged and of the constitutional diseases of the higher age groups.

According to Dublin[1] all age groups up to and including 35 to 44 show decrease in mortality-rates for males for 1911 in comparison with those for 1900, the percentage of decrease ranging from 27.66 for the age group of 5 to 9, to 3.70 at the age group of 35 to 44. From this age group onward the rates for 1911 are persistently higher than for the earlier date, the greatest difference being for the age period of 55 to 64, when the percentage of increase reaches 6.92. It has been found that this increase is due to the increase of mortality from constitutional diseases. There has, for instance, been the following increase from 1900 to 1910 in the mortality from the following diseases:

Cancer	30.6 per cent.
Diabetes	60.0 "
Organic diseases of the heart . . .	39.3 "
Diseases of the arteries	396.2 "

The diseases from which persons at the higher age groups succumb are mostly those of the heart, arteries, and kidneys. The main problems therefore are those of prevention of the constitutional diseases, due to the impairment of the circulation and elimination.

The nurse, in performing her multifarious duties in public health work, must not only be able to educate the public and the individuals under her care in the precepts of public and personal hygiene, but is also expected to practise what she preaches, be in robust and perfect

[1] Possibilities of Reducing Mortality at the Higher Age Groups. Louis I. Dublin.

health, and follow the right methods of living and the precepts of her hygienic teachings to others.

Activity and Rest.—Muscular activity is a necessary physiological state of every animal being. Normal rhythmic contraction and expansion of the muscular fibers of the body are necessary for the well-being of the individual. Prolonged disuse of the muscles lead to atrophy and death. Oxidation and bodily metabolism depend upon muscular work. Hence normal living demands a certain modicum of activity of all bodily organs, exercise of voluntary muscles, and general activity upon the part of the individual.

Exercise, while absolutely necessary for well-being, must, however, be carried on with care and moderation. Overuse of certain organs and too violent exercise may be as detrimental to health as lack of use or disuse of the organs. Exercise must also be moderated according to age, occupation, and condition of the individual. What is permissible to younger persons may do harm if attempted by the aged. Persons engaged in strenuous occupations have all the exercise, or, perhaps more, than they need within their occupations. Persons who are engaged in sedentary work need considerable exercise outside of their occupation. For these, walking is perhaps the best exercise if pursued in the outside air and continued at least an hour a day. Bodily exercise should not mean all work, but should also include play. The value of recreation and play has not been recognized as well as it should. In all activities involving bodily exercise, play and recreation should be given their time and part.

Indispensable as are activity and work to the well-being of the individual, they would do untold harm if not followed and interrupted by periods of rest. Rest and sleep are as indispensable as work and play. Perhaps not all of us are able to take and enjoy at least eight hours of the twenty-four for sleep, but all should try to get as near the ideal number of hours of sleep as possible. Nurses, especially, are often compelled to go long stretches without sufficient sleep and to do much work without sufficient rest. That insufficient sleep and inadequate rest are a great detriment to the health of the person no one knows better than the trained nurse. Hence it is important for her not only to take care for her own health in this respect, but also to teach to others the gospel of proper rest and recreation.

Food and Dietetics.—Food is necessary to repair the bodily wastes and to replenish the energy lost by the constant oxidation going on within the body. The amount of food required each twenty-four hours for each individual, or the daily ration of food is of importance to the body metabolism and to the well-being of each individual. It is difficult to lay down fast rules or definite standards as to the exact amount of food needed for each individual. Not only do authorities differ greatly on the subject, but there is naturally a great difference in the individual requirements, a difference based on age, sex, height, weight, activities and other factors. It is natural that children need less food than adults; females less than males; small persons less than large; those at rest or in inactive occupations less than those robust, active and performing strenuous work.

Modern scientists have determined that the average person requires between 2500 and 3500 calories every twenty-four hours. The smaller number of calories is required by the average adult engaged in sedentary or clerical work, while the larger number of calories is required by the average individual in active and strenuous occupations. An increase or decrease of from 200 to 500 calories in the necessary daily ration may not lead to much harm in the young and growing age, but may be detrimental to the health of persons above forty, whose metabolism is much slower and more easily disturbed.

The comparative amount of protein which must be taken in the daily ration is still a subject of controversy. There is no doubt that Americans especially consume too great a proportion of protein in their food, because of their excessive use of foods which have a high protein content, such as fish, meat, eggs, cheese, etc. Modern scientists claim that protein should not exceed 10 per cent. of the total nutriment taken in. This would allow from 250 to 350 calories of protein for the daily ration. Fifty to 100 grams of protein nutriment a day should be more than sufficient for all bodily requirements.

The proportion of fat and carbohydrates in the daily ration is comparatively of less importance, although a good proportion would be 30 per cent. of fat and 60 per cent. of carbohydrates.

The Caloric Value of Food.—There is as yet a great deal of misconception as to the approximate caloric value of the portions of ordinary food daily consumed by individuals. The following table,[1] giving the ordinary common foods, with the hundred calories value thereof, may be of interest to nurses in their calculations of balanced rations:

[1] From Fisher and Fisk, "How to Live."

	Portion containing 100 calories roughly described.	Weight of 100 calories, ounces.	Per cent of:		
			Protein.	Fat.	Carbo-hydrate.
	VEGETABLES.				
Beans, baked, canned	Small side dish	2.66	21.0	18.0	61.0
Beans, lima, canned	Large side dish	4.44	21.0	4.0	75.0
Beans, string, cooked	Five servings	16.66	15.0	48.0	37.0
Beets, edible portion, cooked	Three servings	8.7	2.0	23.0	75.0
Cauliflower, as purchased, average	......	11.0	23.0	15.0	62.0
Corn, sweet, cooked	One side dish	3.5	13.0	10.0	77.0
Parsnips, edible portion, average	One and a half servings	5.3	10.0	7.0	83.0
Peas, green, canned	Two servings	6.3	25.0	3.0	72.0
Potatoes, baked	One good sized	3.05	11.0	1.0	88.0
Potatoes, boiled	One large sized	3.62	11.0	1.0	88.0
Potatoes, mashed (creamed)	One serving	3.14	10.0	25.0	65.0
Potatoes, steamed	One serving	3.57	11.0	1.0	88.0
Potatoes, chips	One-half serving	0.6	4.0	63.0	33.0
Potatoes, sweet, cooked	Half of average potato	1.7	6.0	9.0	85.0
Pumpkins, edible portion, average	......	13.0	15.0	4.0	81.0
Spinach, cooked, as purchased	Two ordinary servings	6.1	15.0	66.0	19.0
Succotash, canned, as purchased, average	Ordinary serving	3.5	15.0	9.0	76.0
Tomatoes, fresh, as purchased, average	Four average tomatoes	15.0	15.0	16.0	69.0
	FRUITS (FRESH OR COOKED).				
Apples, as purchased	Two apples	7.3	3.0	7.0	90.0
Bananas, yellow, edible portion, average	One large	3.5	5.0	5.0	90.0
Cantaloupe	Half ordinary serving	8.6	6.0	0.0	94.0
Grape juice	Small glass	4.2	0.0	0.0	100.0
Olives, ripe	About seven olives	1.31	2.0	91.0	7.0
Oranges, as purchased, average	One very large	9.4	6.0	3.0	91.0
Oranges, juice	Large glass	6.62	0.0	0.0	100.0
Peaches, as purchased, average	Three ordinary	10.0	7.0	2.0	91.0
Peaches, sauce	Ordinary serving	4.78	4.0	2.0	94.0
Peaches, juice	Ordinary glass	4.80	0.0	0.0	100.0
Pears	One large pear	5.4	4.0	7.0	89.0
Pears, sauce	......	3.98	3.0	4.0	93.0
Strawberries, as purchased, average	Two servings	9.1	10.0	15.0	75.0

	COOKED MEATS.				
Beef, round, boiled (fat)	Small serving	1.3	40.0	60.0	
Beef, round, boiled (lean)	Large serving	2.2	90.0	10.0	
Beef, round, boiled (med.)	Small serving	1.6	60.0	40.0	
Chicken, as purchased, canned	One thin slice	0.96	23.0	77.0	
Lamb chops, boiled, edible portion	One small chop	0.96	24.0	76.0	
Lamb, leg, roast	Ordinary serving	1.8	40.0	60.0	
Mutton, leg, boiled	Large serving	1.2	35.0	65.0	
Pork, ham, boiled (fat)	Small serving	0.73	14.0	86.0	
Pork, ham, boiled	Ordinary serving	1.1	28.0	72.0	
Pork, ham, roasted (fat)	Small serving	0.96	19.0	81.0	
Turkey, as purchased, canned	Small serving	0.99	23.0	77.0	
Veal, leg, boiled	Large serving	2.4	73.0	27.0	
CAKES, PASTRY, PUDDING AND DESSERTS.					
Cake, chocolate layer, as purchased	Half ordinary square piece	0.98	7.0	22.0	71.0
Cake, gingerbread, as purchased	Half ordinary square piece	0.96	6.0	23.0	71.0
Cake, sponge, as purchased	Small piece	0.89	7.0	25.0	68.0
Custard, milk	Ordinary cup	4.29	26.0	56.0	18.0
Custard, tapioca	Two-thirds ordinary cup	2.45	9.0	12.0	79.0
Doughnuts, as purchased	Half a doughnut	0.8	6.0	45.0	49.0
Pie, apple, as purchased	One-third ordinary piece	1.3	5.0	32.0	63.0
Pie, cream, as purchased	One-fourth ordinary piece	1.1	5.0	32.0	63.0
Pie, custard, as purchased	One-third ordinary piece	1.9	9.0	32.0	59.0
Pie, lemon, as purchased	One-third ordinary piece	1.35	6.0	36.0	58.0
Pie, mince, as purchased	One-fourth ordinary piece	1.2	8.0	38.0	54.0
Pie, squash, as purchased	One-third ordinary piece	1.9	10.0	42.0	48.0
Pudding, apple sago	......	3.02	6.0	3.0	91.0
Pudding, brown betty	Half ordinary serving	2.0	7.0	12.0	81.0
Pudding, cream rice	Very small serving	2.65	8.0	13.0	79.0
Pudding, Indian meal	Half ordinary serving	2.0	12.0	25.0	63.0
Pudding, apple tapioca	Small serving	2.8	1.0	1.0	98.0
Tapioca, cooked	Ordinary serving	3.85	1.0	1.0	98.0
Figs, edible portion, average	One large	1.1	5.0	0.0	95.0
Prunes, edible portion, average	Three large	1.14	3.0	0.0	97.0
	CEREALS.				
Bread, brown, as purchased, average	Ordinary thick slice	1.5	9.0	7.0	84.0
Bread, white, home-made, as purchased	Ordinary thick slice	1.3	13.0	6.0	81.0
Corn flakes, toasted	Ordinary cereal dishful	0.97	11.0	1.0	88.0
Crackers, graham, as purchased	Two crackers	0.82	9.0	20.0	71.0
Crackers, oatmeal, as purchased	Two crackers	0.81	11.0	24.0	65.0
Macaroni, average, cooked	Ordinary serving	3.85	14.0	15.0	71.0
Oatmeal, average, boiled	One and a half serving	5.6	18.0	7.0	75.0
Rice, boiled, average	Ordinary cereal dish	3.1	10.0	1.0	89.0
Rolls, Vienna, as purchased, average	One large roll	1.2	12.0	7.0	81.0
Shredded Wheat	One biscuit	0.94	13.0	4.5	82.5
Zwieback	Size of thick slice of bread	0.81	9.0	21.0	70.0

	Portion containing 100 calories roughly described.	Weight of 100 calories, ounces.	Per cent. of Protein.	Fat.	Carbo-hydrate.
	DAIRY PRODUCTS.				
Butter, as purchased	Ordinary pat or ball	0.44	0.5	99.5	
Buttermilk, as purchased	One and a half glasses	9.7	34.0	12.0	54.0
Cheese, American, pale, as purchased	One and a half cubic inches	0.77	25.0	73.0	2.0
Cheese, cottage, as purchased	Four cubic inches	3.12	76.0	8.0	16.0
Cheese, full cream, as purchased	One and a half cubic inches	0.82	25.0	73.0	2.0
Cheese, Swiss, as purchased	One and a half cubic inches	0.8	25.0	74.0	1.0
Cream	One-quarter ordinary glass	1.7	5.0	86.0	9.0
Milk, condensed, sweetened, as purchased	......	1.06	10.0	23.0	67.0
Milk, skimmed, as purchased	One and a half glasses	9.4	37.0	7.0	56.0
Milk, whole, as purchased	Small glass	4.9	19.0	52.0	29.0
	SWEETS.				
Sugar, granulated	Three teaspoonfuls or one and a half lumps	0.86	0.0	0.0	100.0
Syrup, maple	Four teaspoonfuls	1.2	0.0	0.0	100.0
	NUTS.				
Almonds, edible portion, average	About eight	0.53	13.0	77.0	10.0
Brazil nuts, edible portion	Three ordinary size	0.49	10.0	86.0	4.0
Filberts, edible portion, average	Ten nuts	0.48	9.0	84.0	7.0
Peanuts, edible portion, average	Thirteen double	0.62	20.0	63.0	17.0
Pecans, polished, edible portion	About eight	0.46	6.0	87.0	7.0
Pine nuts (pignolias) edible portion	About eighty	0.56	22.0	74.0	4.0
Walnuts, California, edible portion	About six	0.48	10.0	83.0	7.0
	MISCELLANEOUS.				
Eggs, hen's, boiled	One large egg	2.1	32.0	68.0	
Eggs, hen's, whites	......	6.4	100.0		
Eggs, hen's, yolks	Two yolks	0.94	17.0	83.0	
Omelet	......	3.3	34.0	60.0	6.0
Soup, beef, as purchased, average	......	13.0	69.0	14.0	17.0
Soup, bean, as purchased, average	Very large plate	5.4	20.0	20.0	60.0
Soup, cream of celery, as purchased, average	Two plates	6.3	16.0	47.0	37.0
Consomme, as purchased	......	29.0	85.0	0.0	15.0
Clam chowder, as purchased	Two plates	8.25	17.0	18.0	65.0

Elimination.—The metabolism of the body implies not only the intake of foods and their proper digestion and assimilation in the body, but also the elimination from the body of the waste products of digestion, metabolism, and oxidation.

The skin, the kidneys and the intestines are the principal bodily organs taking care of the proper elimination of bodily wastes.

The hygiene of the skin implies proper care, frequent and periodical bathing, and proper clothing for the body.

The activities of the kidneys and the proper elimination of bodily wastes through the kidneys and urinary canals are the most important functions of the body. The efficiency of these excretory organs is absolutely necessary to health and life. Disturbances of these organs lead to ill-health, disease and premature mortality.

Intestinal elimination is another of the most important functions of the body. Intestinal stasis and habitual constipation are foes of health and life. The ingestion of foods containing a large percentage of cellulose, the eating of vegetables, bran constitutents of cereals, and other bulky foods are necessary for the proper intestinal digestion and elimination. Bodily activity and exercise are also conducive to the same result.

Personal Hygiene of the Child.—This differs in its practical application according to age. There is necessarily a difference in the rules and regulations for the care and promotion of health of infants, of children under school age, of school children, and of adolescents. The general principles, however, are identical with those which have been described as relating to all persons, whether children or adults. The rules of health are essentially those of proper feeding, clothing, exercise, bathing, and physical and mental training. Infants and young children demand more attention and closer supervision than do the older children.

Milk and milk foods are almost the exclusive articles of food for infants under one year. There is at present a tendency to regard the digestion of raw cows' milk as difficult in view of its immediate curdling within the stomach. The objections against pasteurization and sterilization of milk for infants' foods are not considered serious. The modification of milk by changing the percentage of the proteid and fat constitutents has become a regular practice in infant feeding.

As to clothing of infants, the opinion seems to prevail that woollen garments have the advantage over cotton and linen. The exposure of the legs or other parts of the body is to be avoided.

Bathing in tepid water, 100° to 110° F., is best done before the last feeding in the evening. Regularity in the discharge of the bowels should be encouraged. Sponging with water, 70° to 90° F., is a good routine practice in the morning.

As the child grows older, cereals, fruits, vegetables, and bread products may be added to the diet. The feedings should be at regular periods. Evening bathing in tepid water and morning sponging with cool water should be continued, and physical exercise and play should be encouraged.

Young infants as well as older children should be kept in the fresh air as much and as long as possible.

Outdoor play and exercise for older children should be encouraged. Sugar and confectionery seem to be well borne and digested by children. They should not be used in excess, however, or in the intervals between feedings, but should be given during each feeding.

A slight rise of temperature in children is no indication of pathological conditions, as it may be caused by overfeeding, constipation, diarrhea, excitement, etc.

The care of infants and children during sickness cannot be discussed here.

The hygiene of the school child has been discussed in Chapter IV, but mention must be made here of the care of school children in their homes. The gain is slight if hygienic conditions surround the child in the school, but are neglected in the home. Instructions should be given to mothers in the care, feeding, etc., of the school child while it is in the home, so as not to counteract the beneficial influences of school life. The most important rule for the care of the school child while in its home is the proper provision of substantial and digestible breakfasts so that the child does not leave the house fasting or hungry. After the child is confined within the school for a number of hours it is the duty of its parents to keep it in the fresh air and to allow it to play and exercise outdoors during the part of the day when it is out of school. Too many children are given home tasks and too many children are unfortunately compelled to do some home work during the afternoons and evenings after school hours. During adolescence the nervous equilibrium is easily disturbed and much intelligent care is necessary to prevent nervous break-down. Intelligent instruction in the elements of physiology and in sexual hygiene is necessary for the promotion of the health of the child and for the prevention of various indiscretions and abuses.

Personal Hygiene of the Aged.—The personal hygiene of the aged differs greatly from the hygiene of younger persons. There is considerable difference in the exact age when a person seems or becomes old. Some are old at thirty, while others are young at seventy; nor does old age come on suddenly without previous due notice. Rather it creeps on gradually and slowly. A person is said to be as old as his heart and his arteries. The main indications, therefore, for the care of the aged is in the care of the circulatory system and the prevention of overstrain and fatigue.

Indiscretions, overindulgence, exposure, and irregular life are more dangerous in the old than in the young, for the recuperative powers are much lessened in the aged. Much less sleep is needed by the aged, although more prolonged periods of rest are necessary. Too strenuous exercise must be avoided. There is need of much less food and there is greater danger from overfeeding. Bathing with cold water must be done with care, and perhaps avoided, unless the body is accustomed to the effects of cold water. The effects of certain shocks are dangerous. Warm woollen clothing should be worn in moderate as well as in cold weather. The best exercise for the aged is walking outdoors. Golfing is considered a good exercise for the aged who can afford it. There are very few hard-and-fast rules for the aged as well as for the young. Constitutional differences and environmental conditions invalidate universal and uniform laws of health.

Personal Hygiene of the Sick.—The rules guiding the nurse in the care of the ill, the convalescent, and the diseased must necessarily differ according to the age and condition of the sick person, and especially according to the character, degree, and severity of the disease from which the person suffers. Here, again, common sense and intelligence are perhaps more important than set rules and regulations.

The feeding of sick persons must be done with care and according to the instructions of the physician, who alone is competent to judge of the necessary amounts of food required as well as of the kinds of food needed. As a rule, sick persons need more digestible and better prepared foods, at more frequent intervals, than do well persons. The nurse should learn the art of preparing certain foods and articles of diet which are appropriate for the sick.

The bathing of sick persons is a procedure which should be done only according to the directions of a physician. Cold water must be used judiciously and with great care. Bed-ridden patients need special care to prevent bed-sores. This can be accomplished by proper care of the bed and bedding, by smoothing out all wrinkles in the bedding, by appropriate support under the sacrum and heels, which are the places principally affected by bed-sores, and by massage of the body and special parts of the body as well as by alcohol rubs, inunctions, etc.

INDEX.

A

ACCIDENTS in occupations, 186
  prevention of, 186
Acetylene gas, 28
Adulteration of foods, 99
  of meat, 100
  of milk, 128
Aged, personal hygiene of, 252
Agents of transmission of infectious diseases, 198
Air, carbonic acid in, 30
    increase and decrease of, 33
  changes due to combustion and illumination, 31
    in houses, 31
  composition of, 30
  confined, 32
    character and effects of, 32
  diffusion of, 30
  ill effects caused by impure, 33
  impurities in, 31
  influence of, upon health, 32
  moisture in, 30
  sewer, 61
Albuminoids in milk, 117
Animals, 79
  domestic, 79
Aqueducts, 48
Arsenic poisoning, 179
Artificial light, 27

B

BACK pressure traps, 65
Bacteria, infection of meat by, 102
  in milk, 112, 132
Bacterial diseases, 195
Bacteriology, 19
Bath tubs, 70
Berkefeld filter, 53
Blended milk, 123
Brass pipe in plumbing, 59
Building, school, 153
Butter, 124
Buttermilk, 124

C

CALORIC value of foods, 245
Carbohydrates in foods, 91
    Langworthy on, 93
    Rubner on, 93
Carbon dioxide, 74
  monoxide, 74
Carbonic acid in air, 30
Casein in milk, 117
Cellulose in foods, 92
Central heating, 39
Cesspools, 57
Chadwick on sanitary science, 19
Cheese, 125
Chemical cleansing of water, 51
  composition of foods, 90
Child labor, 182
  personal hygiene of, 249
  school, 148
Chimneys, role of, in ventilation, 35
Cholera, milk and, 114
Cleaning of house, 81
  of school building, 156
Coal gas, 28
Colostrum in milk, 120
Composition of water, 42

Condensed milk, 124
Conservation of human resources, 20
Construction of school building, 153
Contagious diseases of school child, 161
Cost of foods, 94
Cow's milk, 116
Cream, 122
gauge in milk testing, 143
production of, 122
Cresols, disinfection by, 213

D

Dangers in occupations, 177
prevention of, 185
Definition of disinfection, 209
of foods, 89
of hygiene, 18
of milk, 127
of sanitary art, 18
law, 18
science, 18
of sanitation, 18
of traps, 63
of ventilation, 34
Deterioration of milk, 131
Dietetics, 93, 244
Diphtheria, milk and, 114
nurse in, 231
Disease, insects in, 81
main causes of, 22
relation of, to housing, 24
water and, 43
Diseases associated with housing conditions, 24
due to milk, 113
infants', milk and, 113
of occupations, 169
parasitic, due to meat, 101
possible prevention of, 22
water-borne, 44
Disinfection, 208
chemical, 212
cresols in, 213
definition of, 209
difficulties of, 208
formaldehyde gas in, 215
lime in, 215
Disinfection, physical, 210
practice of New York City Health Department in, 218
of rooms, 216
of soiled wash, 218
sulphur dioxide in, 215
of walls, 216
Distillation, water, 50
District nurses, 227
general duties of, 228
outfit of, 228
Dust, dangers of, in house, 78
and dirt, 76
dangers of, 77
Prudden, Dr., on removal of, 77
in occupations, 185
prevention of, 185
Dysentery, milk and, 114

E

Effect of occupation on health, 170
Electricity, heating by, 39
Emergency and first-aid treatment in schools by nurse, 162
Endemic diseases, 194
Epidemic diseases, 194
Erysipelas, nurse in, 239
Estimate of food values, 92
Expectation of life, 20
Exposure in infectious diseases, 193

F

Factories, functions and duties of nurse in, 189
Factory inspection, 186
Farr on sanitary science, 19
Fats in foods, 91
in milk, 117
Ferments in milk, 118
Feser's lactoscope, 144
Filters, Berkefeld, 53
Filtration of water, 50, 51
Fire escapes, 26
exits in case of, 26
protection, 25
in housing, 25
Fish foods, 109

Fisher, Professor I., on prolongation of life, 22
First-aid kits, 189
Fixtures, plumbing, 66, 70
Fomites, 200
Foods, 89
adulteration of, 99
baking of, 95
boiling of, 95
caloric value of, 245
canning of, 98
carbohydrates in, 91
care, storage and preservation of, 96
cellulose in, 92
chemical composition of, 90
cooked, 95
cost of, 94
definition of, 89
dietetics and, 244
drying of, 97
estimate of values of, 92
fats in, 91
frying of, 96
game, 108
high temperatures of, 98
milk as, 110
mineral matters in, 91
poultry, 108
preparation of, 93, 95
prepared, 95
preservation of, 96
protein in, 90
raw, 95
roasting of, 96
salting and pickling of, 98
smoking of, 98
steaming of, 96
stewing of, 95
storage of, 96
temperature influence on, 97
vitamins in, 92
water in, 91
Fore-milk, 121
Formaldehyde gas, disinfection by, 215
Fumes in occupations, 180

G

Game, 108
Gas, acetylene, 28
Gas, coal, 28
fixtures, 29
heating by, 39
service, 29
sewer, non-existent, 61, 62
shades, 29
Gases, carbon dioxide, 74
carbon monoxide, 74
fumes and vapors in occupations, 180
house, 74
in occupations, 180
poisons and, 74
smoke and coal-gas, 75
water, 29
Glass, milk, 27
plate, 27
prism, 27
in windows, 27

H

Habitations, hygiene of, 24
Health Department, New York City, practice in regard to disinfection after infectious diseases, 218
insurance, 187
lactometer for milk testing, 146
occupations and, 166
water and, 42
Heating, 37
central, 39
electricity in, 39
gas in, 39
grates in, 38
hot-water, 40
local, 38
means and methods of, 38
regulation of, 41
school, 155
steam in, 41
advantages of, 41
stoves in, 39
Heeren pioscope, 144
Home work, 174, 184
Hot-water heating, 40
supply of, 49
House cleaning, 81
means and methods of, 86

House drain, 60
drainage, 54
insects in, 80
poisons, 75
sewer, 60
waste matters of, 73
water supply of, 48
Housing conditions, 24
fire protection in, 25
important factors in, 25
safety, 25
Humidity, 31
absolute, 31
relative, 31
Hygiene, 17
definitions of, 17
function of, 20
of habitations, 24
of meat, 101
of occupations, 166
personal, 18, 241
public, 18

I

Ice, 53
boxes, 54
Illumination, light and, 26
Immunity in infectious diseases, 204
Impurities, water, 42
Incubation in infectious diseases, 193
Industrial betterment, 181
factors, 171
age and, 172
personal, 171
poisons, 179
Infant diseases, milk and, 113
mortality, milk and, 113
Infectious diseases, 190
bacterial, 195
disinfection in, 208
endemic, 194
epidemic, 194
exposure to, 193
fomites in, 200
incubation in, 193
immunity in, 204
artificial, 205
natural, 204
Infectious diseases, immunity in, passive, 207
inoculation in, 206
modes, vehicles and agents of transmission in, 198
morbific agents, 194
nurse in, in diphtheria, 231
district, 227
general duties of, 228
outfit of, 228
in erysipelas, 239
in measles, 231
in pneumonia, 236
in scarlet fever, 231
in tuberculosis, 230
in typhoid fever, 237
period of invasion of, 193
portals of entry of, 196
principles and practice of prevention of, 201
prophylaxis in, methods of, 203
social, 223
role and function of nurse in prevention of, 226
sanitary measures in, 225
Inoculation in infectious diseases, 206
Iron pipes in plumbing, 59
Insects, 80
in disease, 81
in house, 80
Inspection of milk, 141
Intensity of light, 27

J

Joints of pipes in plumbing, 59

K

Kefir milk, 128
Koumiss milk, 128

L

Lactometer, 145
of Health Department of New York City, 146

Lactometer, Quevenne's, 145
Lactoscope, Feser's, 144
Langworthy on protein and carbohydrates, 93
Lead pipes in plumbing, 59
  poisoning, 179
Length of life, increase of, 21
Life, length of, increase of, 21
Light, artificial, 27
  illumination and, 26
  intensity of, 27
  natural, 26
    amount of, 26
  sunlight, 26
Lighting of school building, 155
Lime, disinfection by, 214

M

Machinery in occupations, safeguarding of, 175
Measles, milk and, 114
  nurse in, 231
Meat and meat supply, 100
  adulteration of, 104
  characteristics of good, 104
  cold storage of, 105
  hygiene of, 101
  infection of, by bacteria, 102
  parasitic diseases due to, 101
  preservation of, 105
    chemical, 106
    heat, 107
  sanitary supervision of, 107
  tapeworms in, 101
  toxins and ptomains in, 102
  trichina in, 101
  unfitness of, 103
    causes of, 103
      diseases of animals, 103
      infection by persons, 104
Mechanical ventilation, 36
Medical inspectors in schools, 159
Mercury in occupations, 179
Milk, abnormal, 121
  adulteration of, 128
    by addition of chemicals, 130
      of coloring matter, 130
      of skim milk, 130
Milk, adulteration of, by addition of water, 128
    by extraction of cream, 129
    by skimming, 129
    by watering, 129
  albuminoids in, 117
  appearance of, 118
  bacteria in, 112, 132
  blended, 123
  butter in, 124
  buttermilk, 124
  casein in, 117
  cholera and, 114
  color of, 119
  colostrum in, 120
  composition of, 116
  condensed, 124
  cow's, 116
  definition of, 116
    official, 127
  deterioration of, 131
    causes of, 131
  diphtheria and, 114
  diseased bacteria in, 113
  diseases due to, 113
  dysentery and, 114
  fat in, 117
  ferments and gases in, 118
  fore, 121
  importance of, as food, 110
  impurities of, 111
  infant diseases, relation to, 113
    mortality due to, 113
  inspection of, 141
  kefir, 128
  koumyss, 128
  measles and, 114
  mineral matter in, 118
  preservation of, 131
    chemical, 136, 139
      objections to, 140
    cold, 136
    dryness, 134
    high temperature, 135
    low temperature, 134
    mean temperature, 135
    pasteurization, 138
      Rosenau on, 138
    sterilization, 137
  products, 122
  proteids, 117

Milk, reaction of, 119
scarlet fever and, 114
skim, 123
solids in, 117
specific gravity of, 119
standards, official, 126
strippings, 121
sugar in, 117
testing of, 141
by chemical examination, 147
by cream gauge, 143
by Health Department of New York, lactometer in, 146
by lactometer, 145
by lactoscope (Feser), 144
methods of, 141
chemical, 141
physical, 141
by physical examination, 143
by pioscope (Heeren), 144
precautions in, 142
Quevenne lactometer in, 145
specific gravity in, 145
tuberculosis and, 115
typhoid and, 114
variations in, 119
whey, 128
Mineral matter in foods, 91
in milk, 118
in water, 42
Modes of transmission of infectious diseases, 198
Momentum traps, 64
Morbidity in occupations, 168
Morbific agents, 194
Mortality rate, 21
decrease in, 21
from various diseases, 21
in occupations, 167
Myopia in school children, 150

N

Natural light, amount of, 26
ventilation, 34
Nightingale, Florence, 23
Nurses, district, 227
Nurses, district, general duties of, 228
outfit of, 228
factory, duties of, 189
functions of, 188
increase in number of, 23
in infectious diseases, 226
in diphtheria, 231
in erysipelas, 239
in measles, 231
in pneumonia, 236
role and functions in prevention of, 226
in prophylaxis, 23
in scarlet fever, 231
in tuberculosis, 230
in typhoid, 237
school, 158
advice as to physical defects in children, 162
emergency and first-aid treatment in, 162
functions and duties of, 158
home visits to children by, 159
treatment of certain diseases by, 163

O

Occupations, accidents of, prevention of, 186
child labor in, 182
dangers of, 177
prevention of, 185
specific, 177
diseases of, 169
dusts in, 177
animal, 178
metallic, 178
mineral, 178
prevention of, 185
vegetable, 178
effect of, on health, 170
factory inspection in, 186
first-aid kits in, 189
health and, 166
insurance and, 187
home work, 174, 184
hygiene of, 166
industrial betterment in, 181

Occupations, industrial factors in, 171
personal, 171
age, 172
poisons, 179
arsenic, 179
gases, fumes and vapors, 180
lead, 179
mercury, 179
phosphorus, 179
machinery in, 175
safeguarding of, 175
morbidity in, 168
mortality rate in, 167
nurse in, 188
duties of, 189
functions of, 188
Ogle's tables on, 167
tuberculosis and, 168
women's labor in, 172, 182
working conditions in, 176
workplace, 173
sanitation of, 183
Ogle's tables on occupations, 167
Organic matter in water, 43

P

PAIL system of sewage disposal, 55
Parasites in water, 43
Parasitic diseases due to meat, 101
Pasteurization of milk, 138
Rosenau on, 138
Period of invasion in infectious diseases, 193
Personal hygiene, 241
activity and rest and, 243
of aged, 252
of child, 249
food in, caloric value of, 245
dietetics and, 244
of sick, 253
Petterkoffer on sanitary science, 19
Phosphorus in occupations, 179
Physical defects in school children, 162
examination of milk, 143
Pioscope, Heeren's, 144
Pipes in plumbing, 59, 66
Plumbing, 58
fixtures, 66, 70
bath tubs, 70
refrigerators, 71
pipes, 59, 66
brass, 59
house drain, 60, 67
sewer, 60
iron, 59
joints of, 59
lead, 59
materials for, 58
rain leaders, 60, 70
vent, 65
sediment, 71
size of, 60
soil and waste, 60, 68
branch, 68
construction of, 68
Pneumonia, nurse in, 236
Poisons, house, 75
industrial, 179
Portals of entry in infectious diseases, 196
Precautions in testing milk, 142
Preparation of foods, 93, 95
Prepared foods, 95
Preservation of foods, 95
of meat, 105
of milk, 131
Privies, 56
construction of, 56
sanitary, 56
Privy vaults, 55
Products of milk, 122
Prophylaxis in infectious diseases, 203
role of nurse in, 223
social measures and, 223
Proteids in milk, 117
Protein in foods, 90
Langworthy on, 93
Rubner on, 93
Prudden on dust and its dangers, 77
Ptomaines in meat, 102
Purification of water, 49

Q

QUEVENNE'S lactometer, 145

R

RAIN leader, 60, 70
water, 45
Refrigerators, 71
Rosenau on milk pasteurization, 138
Rubner on protein and carbohydrates, 93

S

SANITARY art, definition of, 18
law, definition of, 18
measures in infectious diseases, 225
science, definition of, 18
supervision of meats, 107
Sanitation, definition of, 18
Scarlet fever, milk and, 114
nurse in, 230
School building, 153
cleaning of, 156
construction of, 153
furniture in, 157
heating of, 155
lighting of, 155
sanitation of, supervision of, 157
ventilation of, 155
water supply of, 156
child, 148
age of, 149
care of, 157
contagious diseases in, 161
defects in, 151
physical, 160
myopia in, 150
teeth of, 150
trachoma in, 165
medical inspectors of, 159
nurse, advice of, as to physical defects, 162
emergency and first-aid treatment by, 162
functions and duties of, 158
School nurse, home visits by 159
treatment of diseases by, 163
methods of, 164
room, influence of, 149
Sediment pipes, 71
Sedimentation of water, 50
Sewage disposal, 54
methods of, 55
combined, 58
pail system, 55
separate, 58
water-carriage, 57
Sewer air, 61
dangers of, 61
gas, 61
non-existent, 62
Sick, personal hygiene of, 253
Siphonage traps, 64
Skim milk, 123
Social measures of prophylaxis in infectious diseases, 223
Soil pipes, 60
Solids, milk, 117
Sources of water supply, 45
Specific gravity of milk, 119
Steam, heating by, 41
Sterilization of milk, 137
Stoves, heating by, 39
Strippings, milk, 121
Subsoil water, 46
Sugar in milk, 117
Sulphur dioxide, disinfection by, 215
Sunlight, 26
Surface water, 46

T

TAPEWORMS in meats, 101
Teeth of school child, 150
Temperature of foods, 97, 98
Testing of milk, 141
Toxins in meats, 101
Trachoma in school child, 165
Traps, 62
back pressure in, 65
definition of, 63
evaporation in, 64
loss of seal in, 63

Traps, momentum in, 64
  siphonage in, 64
Trichina in meats, 101
Tuberculosis, milk and, 115
  nurse in, 230
  occupations and, 168
Typhoid fever, milk and, 114
  nurse in, 237

U

Underground water, 47

V

Vapors in occupations, 180
Vehicles of transmission of infectious diseases, 198
Vent pipes, 65
  size of, 70
Ventilation, 34
  definition of, 34
  devices for, 36
  differences of temperatures and, 35
  mechanical, 36
    advantages of, 37
  methods of, 35
  natural, 34
  role of chimneys in, 35
  of school buildings, 155
Vital statistics, 19
Vitamines in foods, 97, 98

W

Waste matters, 73
  house, 73
  water and sewage, 73
Waste pipes, 60, 68
Water, 42
  aqueducts, 48
  boiling of, 50
  borne diseases, 44
  characteristics of good, 44
  chemical cleansing of, 51
  composition of, 42
  disease and, 43
  distillation of, 50
  filters, 53
    Berkefeld, 53
  filtration of, 50, 51
  in foods, 91
  gas, 29
  hard or soft, 45
  impurities of, 42
  minerals, 42
  organic matter in, 43
  parasites in, 43
  purification of, 49
  relation of, to health, 42
  sedimentation of, 50
  supply of, 42
    hot, 49
    house, 48
    sources of, 45
      rain, 45
      subsoil, 46
      surface, 46
  underground, 47
Water-carriage method of sewage disposal, 57
Water-closets, 71
  apartments, 72
  modern, 71
Whey in milk, 128
Windows, area of, 27
  character of, 27
Women's labor, 172, 182
Working conditions, 176
Workplace, 175
  sanitation of, 183