Preface.

Too few of our intelligent people share the modern enlightenment on personal hygiene and allied health problems. Health campaigns always suffer from the inability of the public to comprehend their purposes. Leading physicians and others who are not satisfied with this popular want of hygienic understanding look to the schools for its correction. School hygienists urge that the work of all periods of school life include some instruction concerning the maintenance of health. This text is designed for use in the early college years. It is based upon courses prepared for Junior College students at the University of Chicago, and for students entering the study of medicine at the University of Texas.

I have taken a middle ground between the strictly applied and the physiological methods of teaching hygiene. My aim is not only to outline hygienic practices, but also to show how the functions of the body are affected thereby. If the student sees the connection between such practices and the health of his body, he is the less likely to be led astray by ridiculous fads, or to misapply scientific rules of health. On the other hand, too much stress on physiology diverts the theme of a short course from practical hygiene.

With the idea that scattered collateral reading is no less valuable than text-book study, I have suggested at the end of each chapter some appropriate references. Most of these are selected to afford a broader familiarity with the better
class of popular literature on personal health. A few interesting and non-technical chapters from scientific books are also listed for reading, to illustrate the immediate sources of our principles of hygiene.

I am indebted to Professors Edwin O. Jordan and Dudley B. Reed of Chicago and Harry V. Atkinson of Galveston, to the Reverend James R. Sharp of Nashville, and to my wife, for suggestions and criticisms. Dr. Herman E. Dustin made the diagrams and sketches for me, using specimens in the collections of the University of Texas.

Galveston, Texas, 1924.

W. B. S.
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THE FOUNDATION OF HEALTH.

CHAPTER I.

THE PROBLEM OF HEALTH AND DISEASE.

Hygiene.—Hygiene is the science of health; while in many particulars new, it is in principle very old. The name dates back to that of the goddess Hygieia and the Greek work for health (ἐγείρειν), and even when ancient Greece flourished the study itself was old. Health had been written about centuries before in Egyptian, and it had stirred man’s thoughts before he attempted to write at all. All primitive impulses are directed toward a healthful existence.

The knowledge of health at first was crude and merged into mysticism. Observations could not be made with refinement until modern science opened the way. Science enables us to care for our bodies much more sensibly than could our forbears. Recent advances have come so rapidly, however, that for many they have confused rather than clarified the issue. To be helpful, they must be so comprehended as to augment, and not confusedly supplant, the hygiene of common sense which has come down from antiquity.

Divisions of Hygiene.—Individual or personal hygiene covers what each individual should know in order to preserve his health. His responsibility is broader in an unhealthful than in a healthful locality. The avoidance of intestinal infection is an important personal care in Asiatic countries. To drink unsterilized water or to eat uncooked green foods there would be to invite an attack of dysentery or of typhoid fever. This is not the case in other regions with better sanitary
Principles of personal hygiene are aimed at the preservation of one's health amid existing surroundings. In community life, where one disease threatens many persons, it is often economical to band together, employ a sanitary expert, and treat the problem as a whole. Purification of a polluted water supply is an instance. The person's environment becomes safer by such collective action, which constitutes public hygiene. Instead of personally guarding his health, the individual surrenders his freedom of action and follows the direction of an accepted authority. The community decides for the welfare of all, and not each of its members for his own welfare. One problem after another is passing into the field of public hygiene: Contamination of water and food, contagion, use of habit forming drugs, and even the use of alcoholic drinks.

In the School.—Hygiene has not always attracted the attention of the general student, nor has physical health always been rated as a scholarly attainment. The ancient Greeks emphasized the need of a sound body for a sane mind, but the ascetics who kept learning alive through the dark ages lost this vision. To them the debasement of the body seemed to exalt the mind. Chinese civilization also has represented a wide divergence between mental and physical well-being; the stoop-shouldered learned classes would have abhorred the physique of a coolie laborer. Modern scholars, of the West and of the East, idealize again the outstandingly healthy body and mind. Football and other school athletics are encouraged because they bring into the ideals of students the thought of health. Physical culture departments may concentrate on the few who least need development, but by doing so they lead all the students to admire a high physical standard.

Attainment of Health.—While the athlete is in most respects healthy and has always been accepted as a convenient model of health, the perfectly healthy individual need not be athletic at all. The ancients based their conception of health rather loosely on physical prowess and grace of posture, but with the advent of modern science the conception has crystallized more definitely into that of a proper functioning of all organs.
A model of supreme health might better be sculptured as a composite individual with all body functions perfected, about as the superman has been described.

An understanding by each individual of the needs of his own functions is the means to better health. Imitation of the physical habits of healthy men does not constitute a highway to health, because the functional needs of all individuals are not uniform. While swimming improves the health of most boys, it occasionally kills one whom a defective heart exposes to cramps. The prize fighter’s enviable health can be credited to his pugilistic training, but men without his inherent neuromuscular capacity could be injured by such a course. The aim of personal hygiene is to have each person know how to overcome the impediments of his own bodily functions.

Environmental Hazards.—Raising the function of an organ to its greatest perfection only halfway assures the health of that organ. The athletic attainments from years of training can be wiped out in a day by a rheumatic infection; infection is one of the many adverse powers which stand ready to contest man’s development. The forces of nature are always ready to destroy those who are not protected from them. An unguarded child, without intelligent protection, could hardly survive them. They can burn or freeze, can smash one against the rocks at the foot of a cliff, or can kill the body tissues by an invasion of the germs of disease.

To these hazards of the primitive world, civilization has added its dangers. As man gets away from nature the chances of long life diminish; the industrial worker does not attain the average age of the farmer. The natural environment of man’s origin favors his survival more than the artificial one which he has built up. Powers of destruction lurk in both, however, and to all of the environmental hazards must be added the hereditary taints and other personal faults which stand in the way of normal development. The forces of an enemy can thus be regarded as responsible for all the maladies suffered by man.

Protective Powers.—A condition of health implies the avoidance or surmounting of these obstacles. Man has a pro-
tective faculty with which to overcome them, and into this many factors enter. Ferments and other substances dissolved in the body fluids tend to destroy those germs and germ products which gain admittance. Few would have gained admittance, for the body's structural arrangement is such that the parts subject to attack are the parts least exposed. A tissue which is injured tends to grow and repair itself, and surviving organs do the work of parts which are lost. These shielding and compensating powers have been given the name vital resistance. The trained intelligence is also a protective force, when it supplements and guides our vital resistance.

Natural Resistance.—The resistive capacity is largely an inheritance. Structure and growing properties of tissue, certain instincts for self-preservation, and to a degree the substances which react against germs, all develop naturally. They are handed down from those who went before us. How the ancestral line built up this resistance is a question. Some would have it that as obstacles were encountered our progenitors acquired the power to overcome them and that they passed this power on to their descendants. Others argue that through vagaries of heredity some few chanced to be resistant, while untoward attacks killed off or checked the breeding of all others, so that only those with the greater resistance now have descendants. The first argument reads: Survival requirement—ability to overcome—transmissible trait, and the second just the reverse: Transmissible trait—ability to overcome—survival. Most of the evidence supports the latter view (selective survival), and does not suggest a likelihood that characteristics acquired due to environment can be passed on to offspring.

Acquired Resistance.—Resistant factors for the protection of the individual himself are certainly acquired, to the extent at least of a tremendous increase over what is inherited. Types of intelligence are acquired which protect better than the inherited instincts. In order to overcome certain infections, protective ferment must be increased enormously over what was naturally present. An inherited quality which provides for much of this increase in resistive power is referred to as overrepair of injured tissue.
Most tissues repair themselves by the building of new tissue at the point injured. They build a great excess over the amount destroyed. If the tough layers of skin are worn from the hands, the repair is an excess of this tough skin, or a callous. Repair of broken bone is effected by a thick deposit of bony substance about the point of fracture; later the useless bony excess is gradually absorbed. Similarly, if the germ of scarlet fever attacks the substance protecting the tissues from it, that substance is replaced and reaches such excess that this variety of germ is overcome and cannot ever gain a second foothold.

When sufficiently resisted, therefore, a hostile attack leads to further increase in the resistance. The popular practice of carelessly overtaxing the functions of the body as a means to forcing up the resistance—spoken of as hardening, or as "growing more like a weed than a hothouse plant"—is not unsound in principle. It is better though, to know where

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**Fig 1.**—Overrepair. Bone, several days after fracture.
the limit of endurance lies than to chance it, for permanent or fatal harm is done when the tissues suffer so greatly that they cannot repair themselves.

**Toleration Limit.**—The utmost limit of resistance, beyond which there is no control over an attack of disease, is spoken of as the limit of tolerance, or tolerant limit to that disease. Such limits vary so widely among individuals that the same sort of abuse might further increase one’s resistance but break down another’s. It is this which precludes universal application of any set code of health rules. Natives can endure the tropical sun bareheaded, but only by wearing a protecting helmet can the visitor from temperate zones ward off sunstroke. The limit to most forms of natural resistance varies among individuals, and that to acquired resistance still more. It is usually possible, however, to make a workable estimate of the amount of abuse which a body could stand.

The toleration limit to some antagonistic forces shows itself only by the signs of an approaching breakdown. It is often the prodromal symptoms, which precede the regularly defined course of a disease, that first put people on their guard. By understanding these it is sometimes possible to check or abort the disease in its incipient stage, or if not, to avert some of its consequences. The earliest sign of a contagious disease, for instance, marks the time for isolation from other susceptible people.

**Specificity of Resistance.**—The powers within the body which protect from one particular disease are collectively termed a specific resistance to it. The resistance to scarlet fever above mentioned, with which the patient had been feebly endowed at the start and which multiplied so greatly as he recuperated, resists only this one disease. A specific resistance to many of the infectious diseases is abundantly acquired on recovery, and repetition of the attack becomes unlikely or impossible. Such resistance can be acquired only through an exposure of the tissue to action of the respective germ or of its products; in some fortunate instances this can be brought about otherwise than through an attack of the illness.
Other types of resistance are not limited to particular ailments and are termed general resistance. A healthy tissue is more resistant to many diseases than an injured one. Proper feeding, exercise, and temperance improve the functioning power of tissue and increase its general resistance; the reverse is the case with improper feeding, fatigue and dissipation. Many rules of hygiene are designed for the control of such general factors as these.

Production of Disease.—Health continues so long as the resistive powers of the body rise above the capacity of any destructive agents present. These agents are harmless if they do not exceed the body's toleration limit to them. The campaign for health becomes a strife to subordinate the antagonistic powers; it is not always desirable to wipe them out, for the same powers may be useful. One does not go barefoot because shoes produce corns; instead the shoe is so fitted that its evils are within the control of the foot's resistance. Only the agent which is sufficiently powerful to break the resistance, disturb some function, and do injury, produces disease.

Causative Agents.—Before detailing such functional disturbances, we might briefly survey and systematize the list of injurious agents. For present purposes, it will suffice to classify these into three groups, according to whether they are biological, physical, or personal. First, there are the living parasites, some of them animals, some plants and some bacteria. Second, there are the agents which injure the tissues mechanically, chemically, or by temperature extremes. Finally, there are upsets in the tissue economy from within.

Parasitism.—The first of the three groups requires the most explanation, for to many people germs are hazy and indefinite creatures. Parasites are organisms which attack living matter; from it they get their nourishment, and its life they thereby destroy. Their attack is not with any vicious intent, but because of an unfortunate defect which hinders the assimilation of other food than fresh tissue juices. All three of the kinds of parasites mentioned include many forms which can be fed from human tissues, though some of these show preference for the tissue of other animals.
Typically the unchecked course of a parasitic disease would run somewhat as follows: The germs find a pathway to some tissue on which they can live, and to grow there they kill and dissolve the tissue for food. The tissue is gradually thrown out of function; the patient dies if the function is one necessary to life, as is that of the heart valves. While growing on the tissue, some germs would excrete into the bloodstream a soluble toxin which is carried to and poisons other tissues. Action of toxin on nervous tissue leads often to paralysis or death.

Vegetable Parasites.—Parasites of the first two varieties are tiny plants and animals, usually complicated in structure. Many varieties of either can live, feed, and multiply in one or another of the human tissues. The plants parasitic to man are all fungi. Many of them attack the skin, and many the lung or other deep tissue. Among them are included yeasts (blastomyces), molds (hyphomycetes), and other fungi. Most authorities speak of bacteria also as fungi (schizomycetes) but for convenience we will regard them separately. When the bacteria are excluded, parasitism for human tissue is distributed much less widely through the plant than the animal kingdom.

Animal Parasites.—Four different phyla of the animal kingdom contain forms parasitic to man. Among the arthropods are mites and insects, the parasitic insects including lice, bugs, fleas, flies and mosquitoes. These attack most commonly the skin itself, or the deeper tissues through the skin. Other animal parasites are worms, of which the majority attack the intestine; these are of two phyla, consist-
ing respectively of round and flat worms. The latter include leaf shaped (flukes) and tape shaped (tapeworms) forms. Many varieties of single-celled animals (protozoa) are parasitic; some are found in the blood and others in the intestine.

A group of long spiral forms (spirochetes), either protozoal or closely allied to the protozoa, has many parasitic members. In apparently close relationship with these are the filterable parasites (filterable virus; ultramicroscopic virus). The latter cannot as a rule be seen, even with the highest powered microscope. Some of them pass through a stage of existence in which they do reach microscopic dimensions; various shapes are assumed, among them the long spiral. Of all the parasites, those of this variety alone can be carried with the fluids containing them through a fine pored filter. We recognize the diseases caused and we know that the patient’s blood has the invisible parasite in it, for this blood can transmit the disease to others, but we sometimes can only guess at the nature of the parasite. Most of the parasites of this group cause general systemic infections.

Bacteria.—Bacterial infections are the most frequently encountered of all parasitic diseases. The bacteria constitute an enormous group of living beings, leaning toward the plant but not falling clearly into either of the main biological kingdoms, as ordinarily defined. They are small and simply formed, measuring about \( \frac{1}{250000} \) of an inch across, and taking the form of a sphere (coccus), a rod (bacillus), or a spiral (spirillum). There are conditions under which they assume irregular shapes.

The simple forms break in two after perhaps fifteen or twenty minutes’ growth, each of the two parts then growing and dividing similarly; in this way they reproduce. In some cases there is only one division and in some cases many before the newly formed individuals separate from one another. The rods, which always divide crosswise, can thus form into pairs or chains. Some of the spheres divide off in different directions, which can group them into clumps as well as into pairs or chains. The pair, chain, or clump is not the organism, however, but a group of distinct and functionally independent organisms.
Habitat and Culture.—Bacteria are numerous, as a rule, wherever animals or plants could live. They are found chiefly near the surface of the land. Dust, and likewise whatever dust can reach, usually harbors them. Innumerable billions could be obtained from ordinary foods, water and milk, or from people’s mouths and intestines. Yet, due to minute size, their presence is appreciable only to technical observers. Not only are bacteria for the most part harmless, but in many instances they are of great service to man. Fertility of the soil, many industries, and even public sanitation plants, depend greatly on bacterial activity.

As food for their growth, most bacteria absorb water containing animal or vegetable matter in solution. Laboratory workers feed them with a broth, made from partially digested animal tissue. A solution of commercial peptone and meat extract (*culture bouillon*) is sterilized in cotton plugged test-tubes, and to this broth the bacteria under observation are inserted with a sterilized wire. The precautions are to keep out dust, contaminated with other bacteria. The bacteria in the broth absorb the food dissolved there and reproduce rapidly, until in a few hours they have produced a cloudiness or other visible evidence of growth. This is the *bacterial culture*. For convenience the broth may be soaked up into a mass of gelatin or of a seaweed jelly (*agar-agar*), the solids being melted into the broth by heat. When the mass cools, there is produced a fine sponge of
gelatin or agar-agar filled with the broth, on the flat, solid surface of which the bacteria may be grown.

Pathogenicity.—Comparatively few kinds of bacteria have the capacity for parasitism. Instead of feeding on dead matter alone, these excrete a poison which kills the tissue and converts it into food for themselves. They are called pathogenic. Life on dead matter gradually reduces their power to kill tissue, while life on the living matter gradually increases this potency. Germs are accordingly most dangerous when carried directly from an infected to a healthy person. Their power of destroying life is termed virulence, the highly virulent germs destroying very readily.

Some of the pathogenic bacteria, in addition to killing the tissue for food, excrete a soluble toxin. This is disseminated through the blood stream and destroys tissues other than the one infected. One of the bacteria which is not parasitic at all causes disease and death by excreting a poisonous toxin into foodstuffs.

Germicidal Influences.—Not only is it the adaptation to a new sort of food that diminishes the pathogenicity of a germ when removed from the tissues of a patient. Many of the forces in nature prove actively destructive to them. Some of the pathogenic bacteria can live only at body temperature, and are killed by variations of a few degrees from this. Others suffer from the action of light; light retards the growth of the germ of tuberculosis, for instance, and exposure to sunlight soon kills it. Oxygen prevents the growth of some germs, such as that of tetanus, and they cannot grow in the air; many other bacteria require a considerable supply of oxygen in order to live. A few of the bacteria escape these harmful influences by passing into a spore stage, having nothing to do with reproduction and serving only to keep them alive amid adverse surroundings. A hygienic significance of the bactericidal forces in nature will appear from later chapters.

Antiseptics.—Germs can often be controlled through exposure to agents which kill living matter, such as chemical antiseptics and a boiling temperature. Formalin, compound cresol solution, or carbolic acid are used to disinfect contami-
nated discharges from the body. These agents are about as destructive to tissue as to germs, but only the germs are exposed. It is also possible to prepare a strength of the antiseptic which will destroy germs, but not such tissues as are more resistant to it than the germs are.

Tincture of iodine is widely used to kill bacteria about the skin, though it is somewhat injurious to the tissue as well. Iodine may be used to kill the bacteria in a dirty wound, for the tissue repair remedies any destruction of tissue. Tissue already inflamed has too much bacterial growth to be entirely killed off and the tissue might gain less than it would lose in recuperative power. For application to the body's external membranes, a 10 or 15 per cent solution of argyrol in water is effective. Boric acid solution is often used for copious washes or irrigations; a saturated or half-saturated solution has hardly any destructive effect on the tissue, and to a degree it does destroy germs.

When using any antiseptic on the body, the effect on the tissue as well as on the germ must be thought of. Antiseptics all destroy tissue, unless so weak as to be within the body's toleration limit to them.

Accidents.—The antiseptics would appear with other poisonous chemicals in the second group of producers of disease, as above classified. Little need be said of this group as a whole. The causation of wounds and frostbite is familiar to everyone. Mechanical and chemical injury results, as a rule, from accident. Accidents of childhood occur because the child's mind is not yet an efficient protector, and because the discipline by its elders is loose. Accidents occur industrially because the workman's care of himself is hampered by carelessness, fatigue, or alcoholism, and sometimes because of an unfitness of light, clothing, or working space. Safety-first propaganda, temperance, and proper working conditions are the preventives.

Upsets of Tissue Economy.—The final group of injurious factors, those classified above as upsets of the tissue economy from within, can best be taken up in connection with the respective organic functions. There are such faults as hereditary deformities which render the functions defective.
It is not to be inferred that all inherent shortcomings are in the nature of disease; the reference is only to those that bring about a definite malady. Healthy and properly functioning organs would be stronger in one person than in another.

An inherently normal function can be worn by excessive activity into a condition of disease; the organ becomes strained. Disturbance may also result from depriving a tissue of supplies it needs for its proper functioning; malnutrition ensues.

Defective traits can best be defined when we discuss heredity, and strains, nutritional defects, etc., will be considered together with the functions with which they interfere. Such faults within ourselves can produce disease just as can antagonistic forces in the environment.

Prevention and Cure.—By forethought it is possible to assure the harmlessness of many powers of disease. Action based on such forethought is preventive medicine. It consists either in excluding from the body an antagonist, or in so raising the body’s resistance as to make the attack harmless. Preventive medicine may be contrasted with curative medicine in that the former strives for the continuance of health and the latter for a reacquisition of lost health. Curative medicine follows the same fundamental principle as preventive. Disease results from partial destruction of the body’s vital and resistive forces, and the restoration of this broken resistance constitutes its treatment.

In a few diseases the germs are best destroyed by medicinal preparations, but more commonly the dependence is placed on the resistive substances in the patient himself. The patient goes to bed and waits for his tissues to overcome the antagonist. The usual error of the unskilled consists in doing too much, and particularly in upsetting the physiologic processes with medicines. Modern medicine makes comparatively little use of drugs. The useful medicament is only that which produces in the tissue a specific and needed activity. Curative measures are for the most part entrusted to the physician and therefore assume less importance, in this study, than the preventive.
Health Perspective.—Problems both of prophylaxis and treatment entail the consideration of just how body functions are or might be affected. A true perspective of the problem of health is based on an understanding, first, of what the body's functions are like when at their best; second, of what obstructive powers might tend to interfere; third, of how far the body can be counted on normally to resist such powers; and finally, of what measures might so diminish the obstructions or so increase the resistance that the functioning tissue can overcome them. Most of the succeeding chapters will follow this scheme of presentation, and consider in order the main functions of the body.

Reading.*

General, Hough and Sedgwick, Chapters XVI and XXX. Nature and Disease, Brend, Chapter II. The Problem of Health, J. F. Williams, Chapter II. Resistance to Unfavorable Environment, Sedgwick, Chapter IV. Parasitic Antagonists of Man, Chandler, Chapter I. Bacteria and Their Relationship to Disease, Jordan, Chapters II and VII. Hereditary Determinants of Health, Rapeer, Chapter III.

* See bibliography for titles and publishers of books.
CHAPTER II.

FUNCTIONS OF THE SKIN.

The Body's Envelope.—The skin and mucous membranes serve as an envelope to enclose and support deeper tissues, and to protect them from physical or parasitic injury. The skin and its appendages are chiefly responsible for an attractive appearance. The elimination of any excessive body heat is also accomplished by this outermost tissue. Here, too, nerve endings take note of the environment, by various sensations such as touch, temperature sense, and pain.

Deep Skin.—The skin consists structurally of two layers, an outer or scarf skin (epidermis), and a true or deep skin (derma). While fused together into one coating, the two are distinct in that they consist of different kinds of cells. Cells are the tiny units of construction which make up the body. They measure in most cases less than \( \frac{1}{1000} \) of an inch across, and differ in shape and material according to the sort of tissue which they compose. Most cells have a nucleus, well defined from the rest of the cell, and having a distinctive purpose which will be discussed later.

The cells of the deep skin are long, slender fibers or strands, which interlace and fuse into a tough fibrous tissue (connective tissue). On the strength of this fibrous layer the enclosed tissues depend for such support as the envelope affords. When its continuity is broken by a wound, fibers develop in excess to bridge over the defect. This overgrowth is the scar; the formation of a scar would not follow an injury to the outer skin alone, but only injury to deep skin or other fibrous tissue. Among the fibers which lie closest to the outer skin are innumerable fine bloodvessels and nerve endings. The ridges to be seen in the palms and soles are caused by particularly vascular and sensitive elevations of the deep skin.
Outer Skin.—The cells of the outer or scarf skin (*epithelial cells*) are irregular and variable in form and arrangement, somewhat comparable to the broken rock built into a macadam road except that the individual cells fit and are cemented together. Those next to the true skin have a tall, cylindrical form. Outward from these are many layers of cells, with

![Diagram of Outer Skin Cells](image)

Fig. 4.—Cellular arrangement.

the different dimensions more nearly equal. They are the reproductive or germinal cells of the outer skin, and they are continually in a process of growth and division. As new cells form they force the older ones outward toward the surface, and press them flatter and flatter. The very much flattened cells become tough and horny. Those at the surface are quite thin and scaly, and are gradually rubbed off.
Hair and Scalp.—Hairs grow from sacs (follicles) of outer skin, which dip down into the deep skin. For the larger hairs, the sacs dip through the skin into the coat of fatty tissue beneath. The germinal cells at the bottom of the sac form a root, from which the solid shaft of hair grows outward through the sac’s mouth. The nourishment of the germinal cells, and therefore the growth of hair, depends on the blood circulation. The circulation of the scalp is improved by regular shampoo or by deep and prolonged brushing. Intensive stimulation by washes and ointments is not desirable for ordinary use, but is employed to combat certain diseases of the scalp.

The hair shaft is dead matter, and nothing done to it affects the vitality of the hair. Singeing has no other effect than that of shortening the hair. Curling by heat tends to burn the shaft and make it brittle, but the new hair which grows later is unaffected. Chemical dyes and bleaches color only the dead shaft, as illustrated by the unpleasant contrasts caused by the newly growing hair with its own color. These substances do no harm to living tissues, except in the case of dyes containing lead or certain other chemicals, which are absorbed into scalp as well as hair and may cause dermatitis or systemic poisoning.

Complexion.—The skin derives its color from the blood supply and from the deposit in its outer epithelial layers of pigment. Freckle and tan creams whiten the skin by killing and peeling off the pigmented cells, and a skin so whitened becomes even more susceptible to tanning or freckling if reexposed to sun or wind. The use of these creams often inflames the skin a little, and in still more cases it insidiously harshens the texture. The color due to circulation of blood in the skin is improved by regular massage or the occasional application of hot followed by cold wet cloths.

A substitution of rouge for the natural coloring has become more fashionable, perhaps, than attractive. Some preparations of rouge contain a mercuric salt which in time can react harmfully. Certain preparations for softening and thus “beautifying” the skin similarly contain poisonous quantities of a lead salt. Use of face powder and of the ordinary
toilet preparations other than those mentioned does not interfere with the health of the skin. Cold cream tends to keep the skin from drying out and thus improves it, as cellular growth is not at its best with insufficient moisture.
Claims for some ointments that they supply nourishment as well are baseless, for while certain drugs can be absorbed from the outer surface of the skin, nutritious matter cannot.

**Oily Secretion.**—The moisture and nourishment required for healthful growth of the germinal cells are absorbed from the underlying bloodvessels in the deep skin. A natural secretion of oil coats over the surface to prevent too rapid drying. Additional greasing may be needed in cold and dry weather, if chapping and cracking are to be avoided. Many think that petrolatum is unsuited for use on the face, because of a supposed stimulation of hairy growth, but this is doubtful.

The oil glands (*sebaceous glands*) are sacs which lie in the deep skin and extend sometimes into the fatty tissue beneath; they empty into the hair sacs. All oil pores have hairs growing from them, though many of the hairs are so small as to escape notice. These glands absorb material from about them and convert it into oil, which accumulates in their cavities and then passes out along the shafts of hair. Glands (*Lat.: glans, an acorn*) are tissue nodules of various sorts, and usually are secreting organs.

**Cleansing of Skin.**—Moisture retained by the oily film softens the skin and favors the rubbing off of dead scales and dirt. The oil naturally secreted is hardly enough to provide the degree of cleanliness to which civilized people have accustomed themselves, but efficient cleansing can be accomplished by additional greasing and a rub. Vegetable oils are sometimes so used, or on the face cold cream. Water and soap clean the skin more thoroughly, because soap combines with the skin's oil as well as with the water, and a greasy layer of dirt is removed more completely than by a mere rub.

The complexion remains less soft under frequent washing than it would through use of the cold cream method, for washing exposes the skin more to atmospheric drying. Inflammation of the skin (*dermatitis*) in many instances persists obstinately until washing with water is stopped and the skin protected by an oil. The average skin withstands the harsh effect of soap and water, though its surface perhaps becomes somewhat shinier and harder.
Bathing.—In rare instances an oil rub is preferable to the bath with water. Bath itch and winter itch, in the causation of which the drying out of the skin plays a great part, sometimes cannot be controlled except by a substitution of the oil rub for bathing. The water bath also chills the skin more, and delicate babies are given the oiling in preference. With these exceptions, the bath with water has become a universal institution among refined people and a characteristic of their refinement.

The substitution of a daily bath for the weekly one of a generation ago is beneficial, but less for cleanliness than for circulatory exercise. Warm baths relax the vessels of the skin and produce a blush, while cold baths contract them and lead to blanching. If the heart and general circulation are active, the skin that has been blanched by a cold bath reacts with a blush; this stimulation of vascular contraction and relaxation is the chief purpose of the morning plunge. Old people and those with circulatory disorders might not stand well the strain of this practice. The vessels of a skin already blanched by chilling should be first dilated by a warm bath or by friction or exercise, before the cold bath can be of benefit.

Sweat.—In the elimination of excessive body heat, the general circulatory system coöperates with the skin; the body when overheated sends much of its blood into the skin to be cooled off. The skin throws off the heat through an evaporation of sweat and other means to be taken up in a later chapter. Sweat must absorb heat to vaporize, and for this it uses in part the heat of the body. This is its important service to the body.

The sweat also carries waste matter to the surface, the amount varying with the amount of such waste matter in the body fluids, but this elimination through the skin is insignificant as compared with that through other organs. The sweat gland does not pick up the waste matter by a selective process, as does the kidney; it merely fails to filter out the waste from the fluids it draws on. The sweat gland (see Fig. 5) is a long, slender tube, the inner end of which appears under the microscope as if wound into a ball; into
this inner part of the gland surrounding moisture passes, and from it the moisture is secreted as sweat.

**Disorder of the Glands.**—The sweat glands are less subject to disease than are the oil glands. Excessive functioning, due to hot weather or too much clothing, sometimes inflames them, and leads to the itching and redness known as heat rash or prickly heat. Children and the obese tend more than others to suffer from this. The itching is relieved by any of several dusting powders put up for the purpose, and to a degree by ordinary talcum powder. The liberal use of talcum powder and the wearing of lighter clothing lessens the likelihood of a development of prickly heat.

The oil glands are subject to a greater number of disorders, because of their larger mouths and the presence of hairs. Several disfigurations of the complexion may result. Scaling cells are shed along the walls of the hair sacs as elsewhere, and mix with the oily secretion. If the oil is sluggishly secreted, the accumulation of scales and dirt thickens it to a semisolid plug, which blocks up the pore. Dirt and other dark material colors it at the surface and gives the name blackheads (comedones). A passage to the surface now requires the mechanical aid of massage or squeezing. A blocked-in mass of sebaceous material is sometimes infected and becomes pus.

Marked changes in the skin with enlargement of the pores occurs during adolescence, and at this time the affliction with blackheads and pimples is most common. At this age also, many persons have too oily or too dry a scalp. As maturity advances, these conditions tend to disappear; little can be done to hasten their disappearance except cleanliness and the general hygienic care of the skin.

**Dandruff.**—Dandruff is a shedding from the scalp of dried scales of skin, due to a disorder of the oil glands. The condition appears to be mildly infectious, though there is no clear evidence as to what parasite causes it. Transmission is thought to occur by brush and comb, so the use of these articles in common with persons who have dandruff should be avoided. In occasional cases, the disease attacks areas of skin away from the scalp; the resulting lesion is ill-defined, reddened, and slightly itchy. Home treatment of dandruff
is not likely to prove successful. Pronounced cases are best put in medical hands if they do not yield to the general hygienic care of the scalp. The excessive dryness and scaling is counteracted by the rubbing in of a grease or oil, such as petrolatum or castor oil.

**Infection of Pores.**—Bacteria present in the dirt on the skin often infect the oil pores and cause *folliculitis*. The common form is so mild as to be objectionable only because disfiguring, though severe cases of acute folliculitis do occur. Ordinary pimples (*acne vulgaris*) seem to be caused by an infection of the oil pores by a rod-shaped germ specific to this disease (*acne bacillus*), in combination with the ordinary pus germs present. The pus bacteria are spheres or cocci, the more dangerous types of them developing into chains (*streptococci*).

They are resisted by the *pus cells* from the blood (to be discussed later), which are capable of engulfing and digesting them. Pus consists principally of the bacteria, the debris of tissue destroyed, pus cells, and water.

**Boils.**—If a pore is infected by pus bacteria of high virulence, and especially if this pore is wounded by an ingrowing hair, the infection passes through the wall of the sac into the surrounding tissue. The result is a boil (*furuncle*). Pus forms all about the hair and oil sac, which loosens as the surrounding tissue is destroyed and eventually comes out as the core of the boil. This leaves a cavity which is later filled in by healthy growing tissue.

Surgical procedure shortens the process and makes it less painful. Hot, wet, applications relieve the pain somewhat, but they may spread the infection to other pores. This
secondary folliculitis does not as a rule develop into more boils, as the walls of those pores are not injured. It sometimes occurs that an infection makes its way into a number of nearby pores and causes multiple boils.

**Carbuncle.**—A group of boils is not necessarily a carbuncle, though some speak of it as such. The carbuncle is an infection similar to the boil, but spreading beneath the skin and infecting from beneath the hair saes. Living skin bridges over much of the infective matter, and keeps it from finding its way out. Carbuncles continue to extend and in many cases result fatally. The skin should be widely opened up by a surgeon and the infection treated from its under surface. This does not apply equally to multiple boils, which differ in that they do not extend beneath the skin.

**Impetigo Contagiosa.**—Impetigo contagiosa is a commonly seen pus infection of the skin, usually of children; for children it is highly contagious. It spreads broadly but is quite superficial. The lesion begins with a slight itching and reddening; there follows a little blistering and then the suppuration. The area involved is sometimes so large as to give an angry appearance out of all proportion with the severity of the lesion. The deep skin is not involved and the more superficial infected layers are replaced spontaneously within a few weeks by the growth of healthy cells. Frequent washing with soap keeps crusts from sealing over the lesion and permits the discharge to drain away freely. A favorable reaction may be expected from the application of 5 per cent ammoniated mercury ointment. This ointment may be too harsh for the tender skin of babies, and should not be used on them without a physician's order. A pus forming abrasion, or any other open sore which suppurates, is also likely to yield to this ointment.

**Ringworm.**—The minor pus infections just described, and many parasitic lesions of other types, are to a large degree preventable by cleanliness of the skin. Dirt becomes contaminated with certain plant and animal parasites as well as with bacteria. The ringworms (*tineæ*) are caused by plants which grow in threads among the cells of the outer skin. The moist skin between the toes is commonly attacked by some
of the fungi of ringworm, and from there the infection is conveyed by the fingers to other parts of the body. So long as the affection remains confined to the skin between the toes, people think of it less as a parasitic lesion than a simple erosion with itching. The lesion begins as an itching pimple and extends into a broad, irregularly shaped patch with sharply defined borders. Between the toes it takes on a whitish, macerated appearance, or elsewhere a pink and slightly raised one. Itching continues to be a pronounced characteristic.

The parasite is slowly killed and the lesion healed by any of several irritant chemicals, but there may be recurrences. A fairly effective ointment is a mixture of 2 gm. of salicylic acid and 4 of benzoic acid to 30 of petrolatum. This should be applied at bedtime for several nights. It irritates the tissue and should not be used for too many consecutive nights without allowing the skin an intervening week for recovery. Another remedy which is frequently successful is tincture of iodine, swabbed on at bedtime.

**Bromidrosis.** — The development of ringworm fungi and other parasites about the feet is facilitated by the excessive moisture which collects, due to the wearing of closed shoes, especially patent leather. The infection adds a bad odor to the excessive sweating; this bad-odored sweating is termed *bromidrosis*. The odor is avoided by scrupulous cleanliness, and the lesions cured by a destruction of the parasite. Excessive sweating is prevented by the use of better ventilated footwear. Sandals would be ideal, weather permitting, but the average foot remains healthy in a shoe.

**The Itch.** — The itch mite (*sarcoptes scabiei*) is an animal parasite which burrows into the skin and causes itch (*scabies*). Small itching elevations or blisters appear at the spots where the mites have burrowed in. The parasite prefers a soft and moist area of skin, such as that between the fingers, but it may attack anywhere and a body become covered with the lesions. Cleanliness is a preventive, but the cleanest of people sometimes are infected. The parasite is killed by sulphur; a thorough scrub taken daily and followed by the application of sulphur ointment soon disposes of it. The
use of sulphur has greatly reduced the prevalence of the itch, though in many quarters it is still a common disease. School children and older students often pay little heed to itchy pimples about the hands, which in reality are nests of these mites.

Lice.—Among the insects parasitic to human beings are some kinds of lice. The body louse (*Pediculus vestimenti*), familiarly referred to by war veterans as the “cootie,” lives in the seams of cotton or woolen underwear and migrates to attack the nearby skin. Sterilization of the clothes and a bath rids the infested person of body lice.

The head louse (*Pediculus capitis*), which lives among and attaches its eggs (*nits*) to the hair shafts of the scalp, has the identical appearance of the body louse. It is destroyed by soaking the hair over night in petroleum or kerosene; the oil is washed out the next morning and the hair rinsed with dilute vinegar to dissolve the nits.

The crab-louse (*Phthirius pubis*) infests usually the hairs about the pubic region. Treatment consists in the close clipping of the hair and an application of diluted mercurial ointment. The kerosene or diluted mercurial ointment should be used with caution as it may inflame the skin, especially that of young or other tender-skinned persons; kerosene may be diluted with an equal part of olive oil, or the ointment with petrolatum.
Insect-borne Disease.—The bite of parasitic insects is often the means by which general infections get past the surface barrier of the body. The intact skin wards off such infections very effectively; unlike the surface membranes, it permits their entrance only through injured spots. The bite of blood-sucking insects is one such avenue. The germs of several diseases can attack the tissues of an insect as well as of man; the insect infects itself from a patient and some time later transmits its infection to a healthy person. Less commonly the transmitting insect does not itself become infected, but simply draws the contaminated blood from a patient and reinoculates it in another person.

Appropriate measures for the extermination of the insects are the best protection against these infections. Body lice transmit typhus fever and possibly other diseases, rat fleas bubonic plague, and a species of tick Rocky Mountain spotted fever. In Africa some forms of sleeping sickness are transmitted through the bite of certain flies (tse-tse flies). Our house-fly transports germs, but cannot introduce them through the skin. The worst of the disease-bearing insects in this country are certain species of the mosquito.

Mosquito Bite.—The mosquitoes subject to infection with the germ of malaria all belong to the genus Anopheles. Another mosquito is subject to infection with the germ of yellow fever, and probably the same one with that of dengue. As the males do not bite, it is only the females that infect themselves, and later pass their infection on to healthy persons. In the zones where these diseases prevail health is assured only by the destruction of the offending type of mosquito.

Drainage of swamps helps to destroy the breeding ground of the malaria mosquito, or under some conditions a helpful measure is the planting of top minnows which feed on the larvae. The mosquito which spreads the other diseases mentioned breeds more about the house and yard, and its breeding place is in such water as collects in old cans, etc. A film of oil over water prevents the breeding of mosquitoes by plugging the breathing pores of the larvae. Until the mosquito growth can be brought under control screens are
depended on, especially the screening of patients whose infections would otherwise be broadcast by the mosquitoes.

**Dog Bite.**—Other infections enter through abrasions in the skin not made by insects. The most formidable are tetanus, syphilis, rabies and anthrax. The first two will be discussed in other connections. The germ of rabies can attack the brain, salivary glands and other tissues of any mammalian, from one to another of which it is transmitted through the bite. Pet dogs are not most susceptible, but their close relationship with man renders them most dangerous to him. The disease in the dog may reveal itself by the animal's queer and furious dashing about or, more quietly, by an appearance of ordinary sickness and irritability. In a late stage the animal goes into convulsions and paralyses. The throat muscles are conspicuously involved, and swallowing becomes so painful that the thought of it drives even a very thirsty dog from water; hence the synonym *hydrophobia*, meaning fear of water.

The safety of a person who encounters a mad dog demands simply that he stand aside several feet and out of the way. Rabid dogs attack only those who obstruct them; they do not avoid, but neither do they pursue. Public safety demands the killing of dogs known to be infected, and further that susceptible animals be not allowed to pass body fluids along to one another. As the germ is transmitted only through the saliva, the compulsory muzzling of all dogs at large always proves effective in stamping out the disease.

**Anthrax.**—Anthrax can infect through the skin where scratched raw by contaminated hairs from infected animals, usually cattle or horses from the Orient. Shaving brushes and other articles have harbored spores of the germ for long periods, though most cases of human infection have been among men who work with hides. At the abraded and infected spot there develops most commonly a blister which later breaks down into a blackish slough and is surrounded by inflammatatous hardening of the tissue; the worst cases have a marked puffiness which resolves into extensive sloughing. Fever and other constitutional symptoms accompany the lesion, and in many cases death ensues. Anthrax infec-
tion from sheep enters more often through the membrane of the lung by inhalation of the spores. Infection has rarely occurred through the membrane of the digestive tract.

Active preventive measures are almost entirely in the hands of the public health authorities. They consist in a supervision and disinfection of animal products from suspicious sources. The discharge is highly infective, but transmission from man to man by spread of the discharge is not common.

**Felon.**—Pus infection enters through any sort of break in the skin. A hang-nail infection may result in an abscess or *felon* about or beneath the nail. Surgical treatment often is required for the cure of such infections. Avoidance is by protection of the skin from cracking, by the keeping clean of a crack which does occur, or by a drop of tincture of iodine to kill any germs before inflammation begins.

Nails develop from a shiny layer of cells (*stratum lucidum*) between the growing cells and the more superficial flattened cells of the outer skin. The outermost layers of cells tend to adhere to the growing nail at its upper margin, and are pulled and torn by the nail's growth. Unless these layers are loosened occasionally and pushed back, cracks or hang-nails develop; the pus infections may follow. The dirt which collects about the finger-nails is prolifically supplied with pus germs; it causes infection not only about the nails themselves, but wherever else the skin may be scratched raw.

**Raw Surfaces.**—The avoidance of infection is the most important element in the treatment of small raw spots. Any dirt or foreign matter is first washed out with water or boric acid solution. Tincture of iodine should be painted over once, but this is not to be done repeatedly, as continued application would retard the repair of tissue. The sore is then protected from further bacterial contamination by a dressing and bandage of plain sterile gauze; this dressing need be changed only as frequently as any pus formation might demand. Petrolatum on the gauze prevents its adherence to the wound; this makes less painful the change of dressings and protects the growth of new skin. In the pro-
cess of healing the raw area is first bridged over by an extension from its edges of rapidly multiplying germinal cells. These cells come to form a delicate pinkish film over the surface, which then thickens gradually into normal skin as flat cell and horny layers develop.

The control of infection becomes secondary only if hemorrhage is dangerously profuse. In most types of wound the bleeding is best checked by packing with sterile gauze, and direct pressure over this. An unsterilized cloth may have to be used instead if the bleeding endangers life.

**Bruises.**—Bruises, which discolor but do not break the skin, are treated chiefly for the relief of pain and control of discoloration. A heavy blow is followed by bleeding into the tissues round about, and it is the disintegration product of this blood which disfigures the area. The black eye is an example. Cold applications immediately after the blow tend to check the bleeding and lessen the amount of discoloration. During the succeeding days occasional hot, wet applications hasten the absorption of the blood products. Some “beauty specialists” can expertly paint over and hide black eyes. Bruises elsewhere than about the face cause little concern, unless painful; hot or cold dressings afford some relief from resulting pain.

**Pressure of Shoes.**—Unhygienic footwear causes certain types of mechanical injury. Tight shoes produce their worst effects on the skin by an interference with the circulation. The pressure irritates the skin and reduces its blood supply; this leads to the growth of corns. There is reason to suspect that parasitic fungi might play a part in producing some kinds of corns, but the evidence is insufficient for a definite assertion. The corns disappear when all pressure is avoided. They can be removed by the widely sold salicylic acid corn cures, but tend to recur if the pressure of the shoe is continued. If a corn is to be trimmed the surrounding skin and the knife should first be well cleaned; otherwise a cut too deep may lead to painful infection.

Ingrowing toe-nails are deformities brought about by the pressure of short or tight shoes or of torn shoe linings. They dig into the skin and lead to painful inflammation; suppurat-
ing infection often follows. Proper fitting of the shoes, and the practice of cutting toe-nails straight across instead of rounded, tend to prevent the digging of nails into the flesh. The cure of pronounced cases often requires surgery.

**Burns.**—Burns have been cured by every imaginable variety of treatment. Baking soda has been a favorite home remedy, both dusted on and applied wet. Sunburns are sometimes dusted over with dry soda. Wet compresses of soda, if applied immediately, relieve the pain of small burns and reduce the liability of their blistering. Another method of treatment is the greasing over of the burned surface. Carron oil, a mixture of linseed oil and lime water, has served very widely as a liniment for the treatment of burns. As a precaution against infection, the burned part should be kept as clean as possible.

The very severe burn, or any of second or third degree that involves a large area of the skin, needs medical attention. Burns are recognized as of three degrees. They sometimes redden only (*first degree*), sometimes blister (*second degree*) and sometimes destroy true skin tissue (*third degree*). If one-third of the total surface of the skin is badly burned a fatal outcome is probable. Death may come very shortly from the shock, or it may ensue after many days from a complicating inflammation of the kidney. Products of the burned tissue are absorbed by the blood and inflame the kidneys while being eliminated.

**Frostbite.**—Frostbite whitens and destroys sensation in the frozen area. The application of snow is said by patients to afford immediate relief, while the tissue thaws; the part is afterward rubbed lightly and gradually warmed to room temperature. A frostbitten foot or hand is kept slightly elevated after it has thawed. There follows later an inflammatory stage of swelling and redness, and at this period the management is as varied as for burns.

After a mild frostbite the tissues promptly heal, though as a rule their circulation remains poor, as many of the tiny bloodvessels are lost. The same area becomes less resistant to subsequent freezing. Frostbite of a grade severe enough to shut off bloodvessels of any size results in a sloughing away of part of the tissue.
Chemical Injury.—The corrosion of tissue by chemicals is not greatly different from that by mechanical or thermal agency. First aid consists in washing off part of the chemical and neutralization of the rest. Most acids could be neutralized by soda solution, or alkalis by dilute vinegar. Carbolic acid is removed by alcohol or a fat. After elimination of the chemical the treatment of the lesion is the same as that already described for raw surfaces.

Chemicals in a concentration too weak to corrode may initiate a milder inflammation (chemical dermatitis). The avoidance of further exposure to a chemical known to be injurious is likely to be all that is required for a cure. Unfortunately, the chemical at fault often is not recognized. Many chemicals, as well as agents other than chemicals, produce very similarly appearing cases of dermatitis; the determination of actual cause usually requires medical attention. Formalin and other antiseptic preparations have often inflamed the skin, some individuals being more susceptible than others.

Poison Ivy.—Injurious substances which often attack the skin of campers and others in the woods are the resinous saps of the poison ivy and poison oak plants. The prevention of such poisoning is only through the careful avoidance of the two plants. The leaves of the poison ivy form into clusters of three, and are thereby distinguished from the harmless creepers with five leaves. The poison oak shrub has a broad leaf resembling that of an oak tree. Either of the two harmful saps can be removed with alcohol or by thorough scrubbing with soap immediately after exposure; they are tenacious, and could be merely spread over the skin by a careless rub or wash.

This form of dermatitis begins with a burning sensation, which by the following day develops into a redness of the part, and later into swelling and blistering. The lesions often assume an angry appearance. After inflammation has set in the results of treatment are uncertain. Several preparations have been used with a degree of success, one of which is a 1 per cent solution of permanganate of potash, painted over the lesion. Usually the malady must run its accustomed
course of about two weeks. Care must be taken meantime to avoid the transfer to healthy skin of any of the exudate from the lesion.

Cancer.—Some of the types of new-growths (neoplasms) form another group of skin lesions. The worst of these tumors is the uncontrollable and spreading overgrowth of epithelial tissue called cancer. An important causative factor is the continual or often-repeated injury to which areas of skin are sometimes subjected; the simple irritation of the lip, kept up by a rough pipestem, is a much cited example. It is not always after mechanical injury, however, that cancerous nodules appear.

In the early stage the cancer can be removed, but not after it has had sufficient opportunity for extension. The prevention consists in the avoidance of persistent open sores, or if a cancerous nodule develops in the early removal of that nodule with such nearby tissue as the surgeon deems necessary. It is not until early adulthood is past that such tumors become a real menace.

Warts.—Benign tumors also occur in the skin. Unlike the cancer, they remain localized to the original place of development and have no serious consequences. Warts are benign tumors of the skin, being overgrowths of the epithelial cells at the affected point. Though unsightly, they do no harm and eventually disappear. Many weird remedies have favorably impressed the users, as their application happened to be made shortly before the warts disappeared. Immediate cure is by destruction of the wart and all the surrounding tissue; this can be done by the action of strong acid, of heat, or of freezing, but can hardly be done safely by the inexpert.

Moles.—A mole (naevus) in the skin is usually benign. Spots of different sorts have been called moles; a common type is the swelling due to a local dilatation of small blood-vessels. The pigmented mole is less harmless than other types in that it sometimes becomes cancerous, especially if irritated. Pigmented moles should be removed by a surgeon or else left strictly alone and protected from mechanical irritation. General consideration will be given the tumors
in a later chapter. The skin is only one of many tissues which may be involved.

*Danger in Skin Lesions.*—As mild skin troubles are so often cared for at home, we have in this chapter been concerned with curative as well as preventive medicine. Regardless of appearances, the patient should in all cases consider carefully whether medical attention can safely be dispensed with. No unrecognized lesion should long be allowed to persist, for some that are dangerous simulate mildness. Cancer of the skin appears first as a simple little lump. This and other lesions of the skin need expert attention and need it early. Some types of inflammation affect the skin’s resistance as time goes on, and make recovery progressively harder. A process which involves the deep skin continues to produce scar tissue, and while this limits the spread of the disease it may also interfere with the treatment.

**Reading.***

*General,* Pyle, Section by Fox.
*The Hair,* Pusey, Chapters XI and XII.
*Care of Hair and Nails,* Winslow, Chapter III.
*Baths and Bathing,* Bowers, Chapters IV, V and VI.
*Types of Skin Inflammation,* Cornell, Section on Skin.
*Treatment of Some Skin Diseases,* Cabot, Chapter XVII.
*Animal Parasites of the Skin,* Chandler, Chapter XX.

* See bibliography for titles and publishers of books.
CHAPTER III.

THE MEMBRANOUS COVERING.

Mucous Membrane.—The convenient conception of a complete envelopment of the body tissues by skin and mucous membrane is possible if we regard the cavities within the stomach, bowel, bladder, etc., to be outside the body. A biscuit would enter the body proper when absorbed through the membrane into the blood stream, rather than when swallowed. A marble, if swallowed, would not enter the body at all.

The surfaces which border on the body cavities and are least exposed to the environment are those covered by membrane, as the more exposed are covered by skin. There are two expanses of the membrane. The larger lines the respiratory and digestive tracts, and sends extensions from the throat through the Eustachian tube to the middle ear, from the nose through the tear duct to the eye's surface and through ducts to the sinuses about the facial skull. The other expanse of membrane lines the genital and urinary organs.

Function.—The function of these surface membranes corresponds roughly with that of the skin, though most requirements are less severe as the surfaces are less exposed. All functions listed as of the skin are to some extent those also of the membrane. A function of the membrane which the skin shares to only an insignificant degree is that of passing materials from the outside to the body fluids and vice versa. Dissolved foods pass through the membrane of the bowel, and oxygen and carbon dioxide through that of the lung.

Structure.—The structure of the mucous membrane likewise corresponds roughly with that of the skin. A superficial coat of epithelial cells rests on a deeper fibrous support. The
epithelium is continuous with that of the skin. Generally speaking, the parts adjacent to or not far removed from the skin have many layers of epithelial cells, whereas the parts considerably removed have but a single layer. The single layer of cells is better suited for passing substances through into the body fluids. In the fibrous tissue beneath the epithelial cells are blood vessels and nerves. Glands of epithelial cells dip through at places into or through the fibrous layer; these secrete various fluids which we shall have occasion to consider later.

**Mucus.**—One of the glandular fluids is the rather thick and sticky phlegm, or *mucus*, which gives the membrane its name. The mucus protects the membrane from atmospheric conditions and also from dust and infection. Germs and dust are collected and held mechanically by this sticky fluid, which in its passage carries them on away from the membrane. Too frequent use of antiseptic washes about the mouth, nose, and throat tends to do harm in that it keeps the mucus cleaned away. Unless there is foul breath or other sign of disease, such washes have no hygienic purpose at all.

**Why Teeth Decay.**—Teeth are outgrowths from the mucous membrane. The cause of dental decay, and the body's power of resisting it, are but partly understood. Evidence accumulated from different sources suggests that many factors contribute. Inherent factors enter in, including such placing of the teeth in the gums as to permit or preclude lodgments of food between them. The diseases of infancy are thought to affect the buds which are to develop into teeth, and thus to predetermine the degree of dental health. Soft foods favor the development of cavities, whereas teeth that chew tough food acquire strength and remain solid. Investigators hold that dietary deficiency of mineral salts and vitamins is partly responsible for decay. Acids formed in the ordinary decomposition of surrounding food particles are held to dissolve out the tooth substance, as are the acid products of streptococci, which have been thought by some to invade the tooth in advance of the cavity formation.

Decay of teeth is one of the misfortunes of civilization. The uncivilized Esquimos are comparatively free from it,
and American Indians largely so, while nearly all American and European white people are afflicted. Most of the conditions above listed as favorable to decay are likewise conditions of civilization. Civilized people are more likely to have survived the diseases of babyhood. Furthermore, the refined diner has turned from most of the hard foods, and the rest he chews insufficiently to avoid noise. Soft-cooked foods have lost much of their vitamins and easily decompose about the teeth. The relationship between, or the relative importance of, these several factors which combine to destroy the teeth of civilized man, is not clear.

Care of the Teeth.—Means of prevention are obscured by the confusion as to cause. Authorities usually agree that the teeth are preserved by frequent brushing, at least once daily at bedtime. After teeth are brushed the glands proceed to coat them over with fresh clean mucus; the secretion about them would otherwise become mixed thickly with food matter. If left undisturbed for a period longer than twenty-four hours the mucous films harbor also considerable bacterial growth, with resulting acid products that attack the teeth. Food particles not reached by the brush are best removed with dental floss.

The brushing of teeth cannot be considered all sufficient as a prophylactic against caries. The clean tooth never decays —with the onset of decay it is no longer considered clean—but more than a brush is required to maintain its cleanliness. Proper diet, and the other influences which favor soundness of the teeth, are no less important.

Tartar and Pyorrhea.—If the teeth are not carefully attended to, calcium is the more likely to deposit as tartar. The tartar then harbors bacteria. It is well to have the dentist remove such deposits at regular intervals, the frequency of the treatments depending on the rapidity of the accumulation. Some teeth need dental cleaning every six months, and others not oftener than once every few years. Tartar formation is often associated with a mild inflammation of the gums (gingivitis) which causes the gums to redden and to retract from the teeth.

A more severe inflammation of the gums is the suppurative
pyorrhea. Pyorrheal abscesses develop between the teeth and gums and discharge pus into the mouth. This gives the breath a disagreeable odor, and is among the very common causes for bad breath. If untreated the discharge tends often to become worse, the gums to deform and the teeth to loosen. The condition may improve only with prolonged dental treatment.

**Dental Repair Work.**—Decaying cavities (caries) in teeth enlarge with progressively increasing rapidity, and should by all means be filled early. While the outer layer, or enamel, of the tooth is resistant to moisture and bacterial decay, the deeper layer, or dentin, is not. Moisture diffuses into exposed dentin, and prepares the ground for infection; cavities then enlarge rapidly. Repair of the tooth before the dentin is greatly involved means a much smaller filling.

The milk teeth, as well as the permanent, stand in need of dental fillings if carious, though not necessarily of such durable fillings. During the few years of existence their function is important. Without good teeth the child cannot chew comfortably and acquires a habit of bolting its food. The milk teeth play a part also in the development of the jaws; on this is dependent the regularity of the permanent set.

**Root Abscesses.**—A common sequel of neglected caries is the so-called root abscess, which develops in the jaw about the root of a tooth. This follows a destruction of the pulp, and need be looked for ordinarily only about dead teeth. The pulp of a tooth is the bundle of bloodvessels and nerves which extends into the central cavity of the dentin, to supply nourishment and sensation. When this matter has been destroyed the tooth is no longer sensitive to pain, has no blood supply and is spoken of as dead.

In the process of its decay the infected pulp ferments and forms gas, the pressure of which forces infective material through the tip of the root to the socket in the jaw. This is the common origin of root abscesses. Discomfort is not always caused; only when sufficient pus or gas accumulates to cause considerable pressure in the abscess cavity does aching and swelling occur.
Cancer.—There is occasionally a much more serious sequel to caries. Sores kept raw by broken teeth have developed into cancer; wounding of the surface is not dangerous, but this continued irritation of an open wound is. Cancer can develop in the mucous membrane just as it can in the skin, and the area involved is not infrequently the mouth.

Other parts of the membrane are quite as susceptible. Cancer of the stomach or gall-bladder results from irritation within these organs, and the membrane which lines the uterus is a frequent site. The pain and other symptoms suggestive of stomach trouble, if associated with pallor and loss of weight in people of advanced age, or a bad-odored and bloody uterine discharge, are warnings of the danger of cancer. The management of the condition, as before pointed out, consists in early surgical attention.

Membrane as a Barrier.—In protective power for the deeper tissues the mucous membranes fall far short of the skin. In view of its function of passing needed substances from the outside to the tissues, it might be expected to pass in also harmful materials. As will be discussed in a later chapter, there are poisonous gases which pass the membrane of the lung, and poisonous solutions that of the bowel. What is perhaps worse, the germs of many infectious diseases pass readily through the membrane. Some of them infect and inflame the membrane and involve secondarily the deeper tissues; the germs which attack the membrane are more infective for deep tissues than are those which attack the skin. Others pass through the membrane without inflaming it at all, whether through minute abrasions or intact membrane is not clear. The main point is that some infective agents can get to susceptible tissue if they reach certain parts of the membrane, from which our protection demands that they be kept away.

Sources of Infection.—Intelligent avoidance of this class of germs depends on the source from which they come and on the possibility of blocking the routes by which they approach. The primary source or breeding ground is practically always someone else's tissues which have previously been infected. Inanimate objects can be entirely disregarded, as none of
them breed the germs of serious illness; they may, however, and often do convey the germs. The previously infected individual is likely to be, but is not necessarily, a patient with the disease. In many cases he is not ill, even though the germ does multiply about his tissues. Such people are termed carriers of disease.

Persons are spoken of as carriers only if the germs breed about them; carrying is not in this sense the same as transporting. Carriers of disease may be the patients before they show symptoms or convalescents who continue to harbor the germs after all symptoms have gone. In addition there are individuals who never develop enough symptoms of a disease for diagnosis, but who more or less permanently harbor its germs. Carriers of the diseases of man are, as a rule, human beings, though not always. One type of germ causing tuberculosis in man is bred in cattle. Certain other germs attack lower animals and also man, though many of them are not those which enter through the mucous membrane.

It is convenient to consider the routes of transmission from these primary sources to the healthy membrane in groups, according to the part of the membrane attacked. One group would be those which lead to the upper or lower respiratory membrane; that is, to the membrane about the nose and throat, lungs or bronchial tubes. Another group is of routes to the membrane of the eye, and still another is of those to the genital membrane. A last group is of routes leading to the membrane of the digestive tract, particularly that of the small or large intestine.

Respiratory Invaders.—Routes of the first group are followed by the germs of some general infections, as well as by those of respiratory and throat infections. Germs of smallpox, cerebro-spinal meningitis, infantile paralysis and other diseases not of the respiratory tract, enter the body through this part of the membrane.

These routes are usually short and very direct. Spray coughed out, attendants' hands, and objects handled are contaminated from respiratory secretions or other infective exudates from the infected person. The infective matter is
conveyed thereby to the nose or mouth of some healthy person present, who consequently becomes infected. If transported for any distance before reaching the second party the germs will have lost their infective power. Their numbers are reduced by scattering and perhaps their vitality is lost, through the influence of the distance factor. At all events, the healthy membrane most endangered is that of a person in the presence of the infected one.

This rule has its exceptions. Infective bacilli from a patient with tuberculosis persist for a while in dark and moist corners, and might infect others who afterward go there. Germs of scarlet fever and diphtheria grow in milk, and are transmitted through the milk supply. Very largely, however, the infection through the respiratory membrane involves close proximity of the infecting person with the one infected; this is known as contact infection. Diseases so transmitted are called contagious, and are the most readily communicable of diseases.

Contact Infection.—The reliable protection against respiratory or other contagious diseases lies in distance. Public-health authorities post communicable disease placards to keep those in health away, or else they remove the patients to isolation hospitals. The fact that he is ill isolates the patient to a considerable degree. The great dissemination of germs by him is before his illness puts him in bed, or after he leaves the sick-room; it is this that must be guarded against.

Those who are susceptible and have knowingly been in contact with a case should be watched until it is known that they are not developing the disease, that is, through the period of incubation for that disease. The incubation period is the number of days after infection before the symptoms appear. At the end of this period, the suspect is either obviously ill or is not a danger. The period is a few days for scarlet fever or diphtheria, or about a fortnight for smallpox, chicken pox, measles or whooping-cough.

A greater danger is from convalescents, who continue for an unfortunately variable period to carry the infections. They are isolated until all apparent lesions heal, and for an arbitrary period which is ordinarily enough for riddance of
the germs. Those who carry the germs longer than usual become healthy carriers, and these are often the greatest menace.

**Infection at Large.**—The proportion of apparently well persons who carry germs of disease, while problematic, is certainly not inconsiderable. In the case of diphtheria, it is found that during the season when this disease prevails a considerable percentage of persons carry the germs. Healthy carriers of diphtheria and meningitis can be detected, though carriers of many other contagious diseases cannot. The detectable carriers could not possibly be weeded out of an entire population, and the difficulty is still greater as regards the others. The segregation of all infective foci in the community is therefore out of the question.

A second difficulty is that some infections of this group are so widespread that a separation between the infected and the healthy would not be practicable. The community could not afford to have in isolation all cases with chronic tonsillitis, or all with a pneumococcus or tubercle bacillus infection. Cases and carriers will continue to remain at large, because their condition either is not diagnosed or does not justify isolation.

**Protective Habits.**—The impracticability of a complete segregation of all cases throws our dependence on such hygienic measures as tend to keep their infective secretions from the respiratory membrane of healthy persons. If people can be prevailed on to keep their mouths clean, to cough or sneeze only into handkerchiefs, and not to spit, the danger of a spread of any infection they might carry is lessened. Frequent washing of the hands and an avoidance of the use of towels and cups in common with others, are a help.

Carefully fitted gauze masks are the only really effective precaution for keeping any contamination in spray, dust, or objects handled, from reaching the nose or mouth. Such masks consist of several thicknesses of gauze so tied as to cover the lower part of the face and filter all inhaled air. Their practical use is limited to the protection of susceptible persons who care for patients with contagious disease. The mask should not be removed until the wearer is away from infected persons, and until he has washed his hands. Except
in the presence of a known case of contagious disease, most people would prefer taking an ordinary risk of infection to wearing the mask.

**Diseases of this Group.**—In their effect on the respiratory membrane, the diseases which enter the tissues by this route may be regarded as of three sorts. The first are the diseases which inflame the membrane mildly or not at all, but which pass through to and seriously inflame deeper tissues; the eruptive diseases are examples. The second are the respiratory diseases proper; they inflame the parts of the membrane in the lungs or in the passages leading thereto, and disturb the breathing or the aëration of the blood. More will be said of these sorts when we consider respectively the diseases of childhood and the function of the respiratory tract.

The third sort are those which inflame the membrane of the throat or mouth and do not directly affect the respiratory function. A sensation of soreness develops and other signs according to the nature of the infection. Intense soreness suggests an involvement of tissues underlying the membrane also. Acute sore throat can never be neglected with safety, at all events not until diphtheria has been ruled out as a possible cause.

**The Throat.**—Persons who do not always have available the services of a physician will do well to familiarize themselves with the appearance of the throat. Even where the amateur's diagnosis of throat troubles is not reliable, it is far more trustworthy than the widespread tendency to trust to luck and wait for a sore throat to subside. Viewed from in front, the entire membrane of a normal mouth and throat is uniformly pink. The soft palate appears arched across to separate the mouth in front from the throat, or pharynx, behind. This arch arises from pillars, two to either side, which join above into the single arch. The tonsils appear as rounded or flat nodules of tissue low down between the two pillars. They are often hidden entirely, but appear when the tongue is pressed down with the handle of a spoon. Examination for sore throat is of the tonsils and the pharynx.

**Tonsillitis.**—A common ailment of the throat is *acute follicular tonsillitis*. About a day after the infection has set
in the tonsils become markedly swollen and reddened, and later white spots or patches may appear on them. The patient should be kept at rest in bed, for while the soreness would subside in a few days anyway there is danger that the germs may enter the blood stream and infect also heart-valves, joints, nerves, or other tissues. Such complication may even prove fatal.

Aspirin has often been given for tonsillitis and sometimes a painting over of the tonsils with argyrol or other chemicals, but no medicine or local treatment has sufficient merit to recommend it as a general home remedy. Cold wet cloths or ice-caps about the neck sometimes lessen the aching, and a gargle of hot water in which a little baking soda is dissolved leaves a fresher and cleaner sensation about the mouth.
Chronic tonsillitis, which results in frequently recurrent sore throat, is evidenced by a ragged or irregular surface of the tonsils and by a surrounding area of slightly increased redness. The great danger from the chronic, as from the acute, form of tonsillar infection is that other tissues may secondarily become involved; this will be referred to in the paragraphs on focal infection.

Pharyngitis.—Simple pharyngitis most frequently accompanies a cold in the nose or chest. Slight soreness develops, with a reddened and granular appearance to the back of the throat. The cause of colds is not yet known, and it is of less significance than that of their complications. A complicating infection by a pus germ (pneumococcus) changes the pharyngeal inflammation from a harmless to a formidable type. This pus infection may spread to and along the Eustachian tube until it reaches the middle ear, where it causes the severe and dangerous otitis media. Earache and other pronounced symptoms following a cold call for investigation. The slight stuffiness and impairment of hearing which often accompanies a cold is only an interference with the middle ear's air pressure, by the swelling shut of the Eustachian tube. Extension to the lungs of the complicating pus infection results in bronchopneumonia. Typical lobar pneumonia is also a pneumococcus infection of the lung, but not a complication of pharyngitis or colds.

Diphtheria.—Diphtheria is an infection of the membrane by a certain bacterium (Klebs-Löffler bacillus). The inflammation, most often over the tonsils or pharynx, is characterized by a whitish film of clotted fibrin from the blood seeping out. White patches on the tonsils may be either diphtheritic or due to tonsillitis; if they spread beyond the area of the tonsils, the probability of diphtheria is great. Medical treatment should be instituted as early as possible, because of the soluble toxin which this bacterium produces. The patient's recovery is assured only if the toxin is neutralized by antitoxic serum before its effects are badly felt.

Other Lesions.—Another lesion of the mucous membrane, known as Vincent's angina, consists in a whitish-floored ulcer with well-defined and reddened margins. Either mouth
or pharynx is attacked. While it does not endanger life, this is a troublesome and often persistent infection. It is treated successfully by physicians or dentists, but the treatment must sometimes be a long and tedious one. Mouths are less likely to be infected if kept clean and otherwise cared for.

*Canker sores* are small, whitish spots in the mucous membrane of the mouth, to which poorly nourished persons are especially liable. A cure can often be brought about by the stimulating effect of an irritant solution such as tincture of iodine touched to the spot.

**Gonococcal Infections.**—Another group of transmission routes leads to the membrane of the eye. These also are to be listed under contact infection. The most important invader of the genital membrane is that which causes gonorrhea. This infection will be discussed in a later chapter, together with syphilis. Syphilis enters through an abrasion of either membrane or skin, and is not so likely to gain foothold in the intact membrane itself.

Gonorrhea can attack also the membrane of the eye, and is the worst of the infections which enter through that part of the membrane; it may destroy the entire eye. Profuse pus formation in an inflamed eye suggests the probability of a gonorrheal infection. Any inflammation more severe than a simple reddening should have the attention of an oculist.

**Conjunctivitis.**—Inflammation limited to the conjunctiva is spoken of as *conjunctivitis*; there are several types. The conjunctiva is the membrane which covers the front of the eye, and folds back to cover the under surfaces of the lids. This membrane is exposed to contact infection just as the respiratory membrane is, and can be protected by similar measures. Distance from the infected person is the best preventive, or where that is impossible a scrupulous care to avoid the bringing of the fingers to the eyes.

An inflammation which consists only of a simple redness extending in from the outer edge of the white of the eye is likely to yield to home treatment. Irrigation of the eye may be repeated three or four times a day, preferably by
passing over the membrane a stream of fluid from a bulb syringe. Half saturated boric acid solution is a favorite wash for the eye. The irrigation is sometimes preceded several minutes by a drop of 10 per cent argyrol.

Other Eye Infections.—Redness which is most marked in a narrow circular band about the outer lens indicates a congestion of vessels supplying the accommodation muscle within the eyeball. This reddened circle means therefore that the disease (*iritis*) is within the eye itself, and such a condition should have the specialist's attention. Any inflammation about the eye which does not tend rapidly to subside also needs medical attention.

Trachoma is a chronic infection which at first causes little discomfort and is often neglected. In its early stages it is diagnosed by small granulations scattered over the conjunctiva of the lids. As the disease progresses, the tissue becomes gradually deformed by extensive scar formation. Ulcer or other complication about the outer lens leads in an occasional case to blindness. Early treatment effects a cure, but very little can be done for the advanced case. The contagious element is great, and though the patient may not be uncomfortably ill he should regard himself as a menace until the condition is cured and avoid careless association with others.

The Lids.—A scaling and reddening sometimes occurs along the margins of the lids (*blepharitis*), often with a slight discharge of pus. It is commonly called granular eyelids, a term more properly applied to trachoma. This mild scaling is often associated with either conjunctivitis or eye-strain. Greasing of the lid margin with petrolatum at bedtime will often relieve the condition; if it does not, the probability increases of another ailment as well, and medical attention should be sought.

Styes are sometimes associated with blepharitis or other disturbance about the eye. Sometimes they occur independently. The stye (*hordeolum*) is an infection of the follicle about one of the eyelashes. If the lash involved is pulled out, the inflammation may be expected to subside. A series of styes, one after another, suggests additional trouble about the eye as a cause.
Foreign Bodies in the Eye.—Cinders or other foreign bodies in the eye can often be removed by a moistened swab of sterile cotton, or by a clean handkerchief. Cinders are easily removed from the white of the eye or the membrane beneath the lid. The upper lid, after a little practice, can be everted over a match stem and its under surface exposed; a shallow furrow appears close to the margin, and in this the foreign bodies will often be found. It is unsafe for the inexperienced to remove a cinder from the outer lens. Work on the membrane over this area, which is very sensitive, requires skill and often a local anaesthetic.

Antiseptics.—Mild inflammation of the membranous parts so far discussed reacts well to treatment with argyrol. The solution can be dropped in the eye, swabbed over mouth or throat, sprayed into the nose, etc. Unless the inflammation readily subsides or is recognized as one suitable for home care, the treatment at home is better not depended on for too long.

While active infections are favorably influenced, the use of argyrol has greater value at home as a preventive of infection. The solution is used immediately after infective material has reached the membrane. Argyrol is one of many antiseptic silver compounds which have proven beneficial when applied to mucous membranes.

Intestinal Invaders.—The infective agents that attack the membrane of the digestive tract become harmless less rapidly after their removal from the body than do those already considered. The danger zone is much broader, and most of the infected do not even come near the infecting persons. In this respect these germs are the greater menace. On the other hand, the transmission routes are much more circuitous and are easier to control. The germs leave the patient or carrier chiefly by the bowel discharges, and cannot reach the digestive membranes of others unless swallowed. It is usually through a contamination of food or drink by somebody’s excreta that the infection is transmitted. Transmission does not readily occur through contact.

Sanitation in America has diminished but not eliminated the direct mixture of body waste with water and food; in
some other localities it has not even diminished it. Almost universally in Asiatic countries, and to a less extent in America, the fields are fertilized with human body waste; this waste both contaminates the foods grown and drains into water supplies. Carriers are more largely responsible for the contamination of milk and other foods in this country, and carelessness about disposal of bowel discharges for the contamination of streams.

Diseases of this Group.—Typhoid and the paratyphoid fevers, cholera, and dysentery, are among the worst of the diseases so transmitted; the germs of dysentery attack the mucous membrane of the large intestine, and those of the others that of the small intestine. One form of dysentery is caused by an animal parasite (*Entamoeba histolytica*) and another by any of several closely related bacteria; both are characterized by a diarrhea in which mucus and blood are passed, accompanied by great pain locally and by general symptoms. In cholera there is a profuse diarrhea which removes much of the fluid from the tissues; this dehydration accounts in part for the marked prostration and other general symptoms of the disease. In typhoid fever and the paratyphoid fevers the intestinal are usually overshadowed by general symptoms, and often are entirely absent.

Infected Meats.—In the case of a few diseases, transmission routes of this group are even less direct than those indicated. Disease can be contracted through ingestion of the flesh of animals which were infected before slaughter. A form of food poisoning, to be gone into later, consists in an infection of the intestine by bacteria which had infected the animal and persisted in its tissues. Several of the intestinal worms also are transmitted along this route.

Eggs or larvae of most of the worms enter the intestine as a contamination of drinking water and foods. The larvae of a few, however, must undergo a stage of their development in the flesh of lower animals; they migrate to the flesh of the animal after hatching from worm eggs which the animal has swallowed. These larvae infect man only if he eats the flesh containing them.
Worms. — Infection by one of the tapeworms (*Taenia solium*) or by the trichina (*Trichinella spiralis*) results from the eating of diseased pork which had not been thoroughly cooked; other tapeworms enter similarly with beef or fish. Most serious of these is the trichina, which causes the frequently fatal trichiniasis. Trichina infection is kept alive in rats; the healthy rat is infected by eating tissue of a diseased rat. Hogs which eat infected rats or scraps of diseased pork acquire the infection; they pass it on to man. Tapeworm and trichina diseases are preventable by the thorough cooking of doubtful meats, especially pork. The U. S. Government inspection of meats reduces the danger in this country, as does also the wide employment of cold storage; this will be discussed later.

*Round Worms.*—Eggs of many parasitic round worms are transmitted through water or food from the discharges in which they are laid to healthy alimentary tracts, where they hatch. Infestation with worms is almost world-wide, and

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**Fig. 9.**—Tapeworm. Larva in meat develops to adult in intestine.
is particularly prevalent in warm climates where sanitation is poor. The custom has arisen in many places of self-medication with vermifuges at regular intervals, for the purpose of driving out any worms that chance to be present. This indiscriminate practice is hardly to be commended except where medical diagnosis is not available. Very active treatment under medical supervision for those found infected is a better practice than the mild treatment for all; examination of the bowel discharges shows clearly whether or not eggs of worms are present. Vermifuges depend for their efficacy on toxic constituents, and only the highly toxic ones can be relied on to dislodge the more troublesome worms.

The round worms vary in size from that of a quarter-inch length of hair to that of a pencil. The pinworm (*Oxyuris vermicularis*) infects the lower rectum, chiefly of children, and on migration through the anal opening cause a characteristic itching. The ascaris (*Ascaris lumbricoides*) approximates the size of a slate pencil; it produces either no symptoms or very mild ones. The whipworm (*Trichuris trichiura*) is a little larger than a pin; it also causes but slight symptoms, if any. The mild symptoms due to these latter worms are in the nature of a temporarily nervous disposition and some slight pallor.

*Hookworm.*—Hookworm disease is caused by another intestinal round worm which migrates from the bowel discharges of patients; unlike the others, it does not as a rule enter healthy persons by the mouth but through the skin. The ground is contaminated by excreta of patients, and there the eggs hatch into larvae which soon crawl about; persons who walk barefooted within a few yards of the place are likely to step on them and become infected. Individual prophylaxis consists in wearing shoes or keeping away from hookworm localities. The disease can be stamped out by a proper disposal of excreta and the cure of infected persons.

*Purification of Water.*—Those of the parasites which enter with drinking water are killed by thorough boiling. Household purification of water can be effected also in other ways. The Berkefeld and similar tap filters render bad water safe for drinking if sound and properly adjusted, but frequently
they crack or work loose and then fail to remove germs. A handy treatment for suspicious water is with tasteless and harmless antiseptics, though these cannot be depended on, as can boiling, to destroy the eggs and cysts of animal parasites.

Standing for half an hour with a little chlorinated lime dissolved in it rids water of intestinal bacteria. To the gallon of drinking water is added a teaspoonful of a stock solution, made by dissolving a teaspoonful of bleaching powder in a quart of water. The stock solution, or in a moist atmosphere the bleaching powder itself, goes stale and deteriorates; only the freshly prepared solution made from a reasonably fresh powder is therefore to be depended on. Tablets also are widely sold with directions for the chlorination of water. Tincture of iodine, 2 drops to the quart, has also been found to destroy within one-half hour the dangerous bacteria in contaminated water (method of Hitchens). Nothing surpasses heat for reliability; boiling for a few minutes removes all danger.

Safety of Foods.—Intestinal parasites are killed from most foods in the process of cooking; some foods have been cooked for this one purpose. In many regions where sanitation is unheard of, it is dangerous to eat uncooked salad greens; the latter have sometimes been soaked in mild antiseptics and eaten raw, but this does not rid them of animal parasites.

Milk is the food of which bacterial contamination is most to be dreaded, for in milk at ordinary temperatures most bacteria rapidly multiply. Typhoid fever, scarlet fever, diphtheria, septic sore throat, and one type of tuberculosis, have to a considerable degree been spread in this way. The market milk of most American communities is unsafe, especially for the feeding of babies and children. Milk from an unknown source is not to be trusted, and should be either boiled or heated to 145° F. for twenty or thirty minutes (pasteurization) before use. Pharmacies supply dairy thermometers. After pasteurization the milk must be kept cool; bacteria are reduced to a safe fraction by the heating process, but in a warm place would again multiply. A higher temperature is required for sterilization.
Hands and Flies.—After heating, the food or milk is safe, but there remains the danger of recontamination. The rich bacterial growth on the hands is much decreased by washing but never entirely removed, and a carrier gets disease germs mixed in with the other bacteria present. If he works in a kitchen, or otherwise handles foodstuffs, he passes some of the germs to the foods. Attendants of patients can be a similar menace, by handling other people's foods. Most of the dangers in unpasteurized milk originate from the presence of carriers or sick persons in the dairies.

The surface of the housefly transmits germs of disease just as do dirty hands, though to a less degree. The fly also has a way of vomiting up part of the material previously fed on; fly specks are such material. Into the sugar bowl can be regurgitated any excreta previously eaten by them; flies are filthy in their feeding habits. War on flies is a fundamental part of any campaign for the wiping out of intestinal infection.

Reading*

*See bibliography for titles and publishers of books.
CHAPTER IV.

INFECTION AND IMMUNITY.

Infection.—By infection is meant a parasitic invasion of tissue. The body's first line of defense against this invasion lies in the intelligent avoidance of the germs. An attack by the germs is unheralded, but if their sources are known all possible pathways of approach can be obstructed. Some of the routes by which germs reach the healthy person have been enumerated. Parasites of the more serious ailments inhabit tissue only, and unless under artificial cultivation they die when indefinitely removed from tissue. Protection is through control of the routes from the infected tissue of one individual to the healthy tissues of another.

Sources.—Many of man's infecters cannot be perpetuated except in the tissues of man. Certain others grow in the tissues of lower animals, and may at any time be brought from these to human beings. Prophylactic measures against all of the animal-borne infections must be directed toward the susceptible animals. Bubonic plague and trichiniasis, for instance, affect rats primarily and are stamped out by the destruction of rats.

Those of the infections which develop in the tissues of man alone are to be controlled by the cure of patients and carriers or by the effective guarding of the various routes of transmission from person to person. The reason health officers interest themselves so much more in the disposal of body waste than in that of garbage is that the waste from an infected person may transmit his infection, whereas garbage does not originate from any infective source and therefore is not of consequence in the transmission of disease.

Physical Barriers.—Some mechanical barriers about susceptible tissues form a second line of defense. Germs are nourished only by the tissues they can digest and absorb,
and the structure of the body is such that susceptible tissues are usually innermost. The germs which can destroy skin are not often the ones which can destroy the more vital tissues. The mucous membrane is a poorer barrier than the skin, so the germs which attack it endanger more gravely the deep tissues. Other germs can get in only if an opening through the body’s envelope is made for them.

Some protection is afforded, particularly about the membranes and about wounds, by the outward flow of fluids. Secretions and excretions only occasionally destroy bacteria, but their outward flow regularly washes them away. Glandular tissues and the mucous membranes would otherwise be more susceptible to bacteria. Wounds are also protected from infection by the outward flow of fluids; a short delay before the binding up of small cuts does away with many harmful bacteria.

**Immunity.**—Tissue reactions form a last line of defense, by which the germs that do get in may be ejected. Tissues produce resistive substances (*immune bodies*); after coming into conflict with an invader they produce them very actively. This protective reaction is spoken of as *immunity*. Tissue fluids, by their content of ferments and other dissolved substances, destroy the germs of disease and any products of the germs. Sometimes the tissue reacts quickly, shows pronounced inflammation, and proceeds within a few days or weeks to destroy the invaders. This is *acute disease*. The ailment is *chronic* when its causative forces contend less actively but more persistently with those of the resistance, and the combat drags tediously on and on.

The character of the body’s reaction varies according to the nature of the infection. Certain cells of the body (*phagocytes*) swallow into themselves some kinds of parasites, and proceed to digest them with ferments. Other cells pour into the body fluids the immune substances which they form. These substances encounter the germs and their products in the blood stream, and there dissolve them or otherwise render them harmless.

**Pus Formation.**—The most conspicuous body cells which engulf bacteria are the white cells of the blood (*leukocytes*).
These cells are round and flat, are microscopic in size, and float freely in the blood stream. While always present in the blood, their number increases after the invasion of certain germs. They are attracted to the place of infection, where they draw into themselves and destroy the bacteria. The engulfment of bacteria does not entirely dispose of their poisonous properties, but by escaping as pus the white cells take from the body the harmful products. Drainage of pus from wherever it may have accumulated is a first principle of surgery.

**Focal Infection.**—From the site of infections which the body has not as yet gotten rid of, the blood sometimes carries pus germs to other susceptible tissues. Invading bacteria may gain the complete upper hand and distribute abscesses throughout many parts of the body. This condition is called pyemia, and is one type of septicemia; the multiplication of any kind of germ throughout the body fluids would be called septicemia. A pus infection which is better resisted than this might still gain a foothold in one or two of the most susceptible tissues. Before acutely inflamed tonsils could destroy the infection within them, a secondary inflammation of the joints or of the valves of the heart could occur. In these cases of acute infection, the secondary involvement is spoken of simply as a complication.

Mild pus infections of years' duration may distribute germs intermittently to other tissues, and lead to their infection. From infected tonsils, sinuses, or roots of teeth, where they breed, the germs are carried to joints, nerves, heart valves, or iris, which secondarily inflame. The result is rheumatism, neuritis, endocarditis, or iritis; these are instances of the many diseases which arise in this way. The
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process is called *focal infection*, for from the original lesions as foci, the infection attacks tissue after tissue. The cleaning out of primary foci prevents the development of secondary foci elsewhere. Bacteria of the type usually concerned, certain streptococci, are most prone to attack primarily the mouth and various parts of the upper respiratory tract, but it is not safe to harbor pus infection anywhere in the body.

**Fixed-cell Phagocytes.** — The capacity for engulfment and destruction of bacteria belongs to cells of the fixed tissues as well as to those floating freely in the blood stream. Certain cells of the bloodvessel walls, of the spleen, of the liver and especially of the lymphatic tissue, have this power. Some cells have their greatest power of engulfment over one type of bacteria and others over another. Nodules of tissue (*lymph glands*) which occur here and there throughout the body are so connected as to filter out germs from the fluids passing through the lymphatic vessels. The lymphatic system of vessels collects tissue fluids, or lymph, from all parts of the body and conveys it to the large veins near the heart. It is likely that lymphatic tissue also produces much of the soluble antibody which is poured into the body fluids to combat germs there.

**Enlarged Glands.** — Lymph glands often give evidence of having gathered in tubercle bacilli, which remain in them and die without harming the body. In other instances the germs prove more aggressive than the glandular tissue which has trapped them, and an inflammatory enlargement with some softening ensues. Swelling of the glands to either side of the neck (*cervical lymphadenitis*) is a common instance. The usual germ to cause a marked and persistent enlargement is the tubercle bacillus, which has entered through the tonsils and passed on through lymph vessels to the glands. This is the same organism which causes tuberculosis of the lungs, but the glandular infection need not cause apprehension of a subsequent lung involvement; often it is by an altogether different type of the germ and the same type of germ might attack any of several tissues and remain localized there.

Many cases of glandular enlargement offer little cause for
concern, but as other cases need surgical attention all should be seen by the physician. By early operation the enlarging glands can be completely removed, whereas cases so advanced that extensive softening or involvement of surrounding tissues has taken place, offer difficulties. Simple incision for drainage is preferable to spontaneous rupture, as the latter leaves an ugly scar.

**Tonsils.**—Tonsillar and certain other lymphatic tissue functionates about as do the lymph glands. The tonsils in children are supposed to make the throat safer by entrapping and destroying germs there, but they normally shrink up as age advances and become inactive after the ninth year. Very often an infection exceeds the toleration limit of the tonsil; streptococci overcome the resistance of the tonsil much more often than tubercle bacilli do that of the lymph glands. The tonsils then lose any beneficent function they may have had, and become breeding places for germs. Not only does injury to the throat result from this, but other tissues are likely to be infected from this point as a focus. Furthermore, it is in the tonsils that carriers harbor diphtheria bacilli or pathogenic streptococci.

Tonsils which in the opinion of a conservative specialist have lost their functional power and are given over to bacterial breeding should be completely removed. It is true that the tonsils would later shrink up and tend to give less trouble anyway, but bacteria may continue to breed in small, shrunken tonsils which afford no throat symptoms at all. The old operation of clipping off the tonsils does not stop the multiplication of germs in them; it is rarely of any value, and its use has been practically discontinued.

**Antibodies.**—Instead of engulfing and destroying the germs, many of the tissue cells throw out protective substances which remain in solution in the body fluids. These soluble destroyers are referred to collectively as antibodies. They must encounter two main factors of infection. The poisonous toxins which bacteria excrete are to be acted on and made harmless. Secondly the bacteria themselves, which are living and multiplying in the tissues, are to be killed and their bodies gotten rid of.
The antibodies are all specific; that is, a given antibody counteracts but one injurious factor of one disease. Each individual disease is combated by substances which are powerless against other diseases. Furthermore, the antibody against a germ's toxin does not resist the germ that had produced the toxin; separate antibodies are required for each.

**Antitoxin.**—Bacterial toxins injure the tissue cells. According to one time-honored theory (of Ehrlich) a given toxin attacks only those cells with constituents specifically adapted for combination with it. The attack injures the cell by destroying these specific constituents. The latter are slowly but excessively replaced, unless the injury has stopped cellular growth, through the tendency to overrepair. They reach enormous proportions, and swarm from the tissues into the fluids, as antibody.

Additional toxin which may enter afterward combines with this substance in the blood stream instead of with the same substance in the cells, and the cells are spared. The tissues are therefore protected as soon as they have reacted to the toxin with antibody formation. This particular antibody is called *antitoxin*. The combination of toxin and antitoxin resembles in some respects a simple chemical union. If antitoxic blood serum is put in a test-tube with some toxin, it renders the latter non-toxic. An antitoxin combines only with the one toxin which led to its formation, and does not resist the toxin of any other disease.

**Antitoxic Serum.**—The tissues of a horse which is injected with toxin produce and fill the fluids with antitoxin. The blood serum of this immunized horse is suitably prepared and marketed for the medicinal effect of the antitoxin it contains. When such serum is injected into a patient, infected with bacteria producing the toxin, it relieves him of further toxic effect; the toxin in his system is neutralized by the antitoxin injected. The horse is selected because its size permits large quantities of the antitoxic blood to be drawn without injury.

The injection of the horse's antitoxic serum relieves human tissues by raising an immediate resistance (*passive immunity*) to toxins in the system. The sera of greatest service to
man are those prepared to combat diphtheria and tetanus. To assure a cure, the diphtheria antitoxin must be injected as soon as symptoms become sufficient for diagnosis. Tetanus antitoxin should be administered without waiting for symptoms to develop, after any deep and dirty wound. Symptoms of this disease do not appear until too late for the assured success of the treatment. Use of these two antitoxins ranks very high as a life-saving measure. A fatal outcome of the type of food poisoning called botulism can also be averted by the very early use of an antitoxin.

Preventive Immunization.—The passive immunity acquired by the introduction of an antitoxic serum lasts only until that antitoxin is eliminated from the body, not longer than a few weeks or months. As an enduring protection against the development of a disease, it has no value. On the other hand, an immunity which lasts for many years results if the antitoxin be produced by the activity of the individual’s own tissues (active immunity) through an exposure to the toxin itself. Only the active immunization is satisfactory as a general preventive measure.

Diphtheria toxin, rendered safe for use by mixture with antitoxin (toxin-antitoxin, or T. A.) is injected to the human body and leads in the course of several months to the production of a durable immunity. Three injections are taken at weekly intervals. This inoculation cannot cure the disease as does an injection of antitoxin, but it prevents the development of an attack several months or years subsequently.

Toxins Other Than Bacterial.—The biological toxins with which human tissues may come into conflict are not only those of bacterial origin. There are toxins also of higher plants (phytotoxins) and of animals (zootoxins). The phytotoxins are relatively unimportant, though much technical interest has been attracted to toxic principles in the castor bean and a few other plants. The zootoxins of greatest import in hygiene are the venoms of snakes. Certain arthropods, fish, and toads also produce soluble toxins.

Snake Venoms.—The most poisonous snakes are the cobras and some others of the same family, which are widely distrib-
uted through parts of the Orient. Some of these are considerably more venomous than any of the viper family. Three of the vipers, the rattler, the copperhead, and the water moccasin, are the most dangerous of the domestic snakes; the rattler is much more venomous than the other two. The widespread fear of the rattler is, however, hardly justified by its bite. The venom causes severe inflammation, but is rarely fatal except to infants and children. The supposed cures by the internal use of whisky occur because patients get well regardless of treatment.

The venom of the rattler causes locally a marked swelling, pain, and discoloration, as well as pronounced prostration, nausea, and general discomfort. The respiratory and other paralyses which are characteristic of cobra poisoning do not associate themselves so conspicuously with the bites of vipers.

**Snake-bite.**—First aid after snake-bite consists in an immediate attempt at localization and removal of the toxin. A bandage is wrapped tightly a short distance upward, that is toward the heart, from the bite; a short distance farther up may be placed a second, and then a third bandage. With a sharp knife several deep, criss-cross incisions are made about the point of the bite, for the escape of body fluids containing the venom. Irrigation of the wound, or the popular practice of sucking fluids from it, may be continued until a physician is obtained. One per cent solution of potassium permanganate in water is a fluid commonly recommended for irrigation, due to its oxidizing effect on the toxin, but in its absence water suffices. The bandages are removed after a half-hour but may be replaced if general symptoms follow.

Venom which reaches the general system can be neutralized by antivenins, which correspond precisely with the antitoxins. One preparation counteracts cobra venom and another viper venom. The antivenins are unfortunately scarce in the markets of this country, as snake-bite is so infrequent as to create little demand.

**Arthropod Stings.**—Several of the arthropods have a venomous sting, the effect of the venom in this case being almost
entirely local and comparatively mild. The stings of certain varieties of spiders or tarantulas, of scorpions, and of centipedes, have occasionally been known to cause death in some parts of the world. That of any species native to the United States produces no constitutional effects of any severity and is never fatal.

More widespread are the stinging insects, particularly bees, wasps, hornets and ants. The stings of honey bees have a barb, which holds the sting in the wound. Extraction of the barb is the first step in the treatment. As most venoms of
this class are acid, the treatment by wet compresses of baking soda gives some relief and has come into common use.

**Germicidal Antibodies.**—Explanation of the antibodies which dispose of bacteria and products of bacterial disintegration is more difficult than that of the antitoxins. Antibacterial activity and its associated clinical phenomena can be pictured only by rather free dependence on theory. The formation of antibodies to attack bacterial cells may be explained just as was the formation of antitoxins. Injurious bacterial products stimulate the tissues to elaborate antibodies, and after a period to throw them into the body fluids. This raises the active immunity against that kind of bacteria. The mode of action of these antibodies, however, is very much more complex than is the simple neutralizing action of the antitoxins.

**Split Protein Theory.**—An ingenious hypothesis (of Vaughan), though apparently at variance with some of the evidence, relates many of the phenomena of infection and immunity with a poisonous disintegration product which is regarded to be split by antibodies from the proteins. Bacterial cells consist partly of proteins, organic products the nature of which will be discussed later. Proteins are extremely complicated in chemical structure, but are capable of being broken down by ferments into less and less complex substances. The digestion of bacteria in its first stages kills them, and in the several succeeding stages breaks down their proteins into forms simple enough for elimination from the body. An unfortunate intermediary stage of this digestive process supposedly converts the protein into substances which in part are poisonous, though in the final stages all the products again become harmless.

Infesting bacteria gradually multiply and increase the amount of foreign protein in the system. This protein does no harm for a time, but stimulates the formation of a protective ferment or antibody. After a certain period the ferments have completed their development and begin to be thrown by the tissues into the body fluids. Then they flood the system, and on combating the bacteria they are supposed to liberate poisonous constituents from this great accumulation of foreign
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protein. Thereupon, pronounced symptoms such as prostration and fever appear. In the stage before these symptoms, known as period of incubation, disease may not have been even suspected. After the symptoms appear we speak of the active stage of the disease.

**Vaccination.**—The antibodies are essentially protective, and the bad effects are due not to their presence but to the delay of their production until the foreign substance has accumulated. When present before the infection, they immediately break up any bacteria that enter the body and the protein poisons do not reach a harmful concentration. Vaccination is the introduction of various preparations of germs for the purpose of forcing up the body's content of such an antibody. The split protein theory is presented because of its simplicity; it is not essential to a conception of bactericidal activity, and the idea of a protein poison does not enter into certain other theories.

Whatever be the explanation, there is no questioning the fact that the introduction into the body of certain germs, or their products, does provide the system with protective power; it excites such antibody formation that subsequent exposure to the same germ does not lead to the disease. A well-tolerated dose of the germ is introduced, and this raises the limit of resistance against the attack of this kind of germ.

**Bacterial Vaccines.**—The commonest form of bacterial vaccine is a suspension of killed organisms. Some bacteria, even when killed or disintegrated, are sufficiently reactive to raise an active immunity. Vaccines have been found to combat effectively only a few of the bacterial diseases, however, and their indiscriminate use to counteract all manner of infections is not justified.

Cure of several chronic infections has been attempted through a building up in this way of active immunity, but such treatment has been disappointing and is gradually being abandoned. Various types of pus infection are still treated with vaccines by many physicians. The bacterial vaccine has greater value as a preventive measure. A high degree of protection can be raised in this way against typhoid and allied infections and against cholera; a much smaller degree
of immunity is acquired against pneumonia, plague, and a type of dysentery. Against other bacterial infections the results have been less promising.

**Typhoid Vaccine.**—The vaccine used for the prevention of typhoid and the paratyphoid fevers has done very great service to man. An attack of typhoid fever would bring a reaction of the tissue so severe as to protect throughout life. Vaccination against the same fever, by its milder reaction, protects for two or more years absolutely and for a number of years to some degree. Typhoid fever might be contracted years after the inoculation, but it would probably be a mild attack.

Infections so slight as to be tolerated by the tissues and not produce symptoms probably occur, and have the same effect as a vaccine. This may explain the supposed natural resistance which has sometimes characterized the inhabitants of regions with a high exposure hazard. Typhoid fever strikes down a greater proportion of strangers in such communities than of natives.

**Pasteur Treatment.**—Parasites other than bacteria succumb also, in some instances, to an artificially raised active immunity. Material for protective inoculation against rabies is prepared from the ground-up spinal cords of infected rabbits. The unknown germ of the disease is in this tissue, a suspension of which is injected daily for a period of three weeks (*Pasteur treatment*). The germs given in the earlier doses are weakened by drying, to be better tolerated by the tissues. The treatment was formerly available at institutes only, but it has now been made possible to the family physician.

The incubation period of rabies is so long that the treatment may begin several days after the infecting bite and still raise the resistance in time to prevent the disease. The saliva of rabid dogs is infective for a few days before the symptoms appear, so any dog which has bitten somebody should be watched for about ten days; if it goes mad within this period the bitten person takes treatment. Laboratory examination of tissue from the dog’s brain, for microscopic ovoid bodies (*Negri bodies*) characteristic of rabies and possibly forms of the parasite itself, is also reliably diagnostic.
Smallpox Vaccination.—Protection against smallpox can likewise be developed after exposure to the disease. Immediate vaccination is urgent for all unvaccinated persons who happen to come into the presence of a case of smallpox. As persons usually cannot tell when they are being exposed, a far safer procedure is to anticipate any possible exposure by vaccination. The germ used as vaccine differs in its production of disease from that of smallpox, but it is probably an attenuated type of the same biological form; at all events each immunizes against the other.

The practice of vaccination originated from the discovery that farmers and others who had had cowpox did not contract smallpox. Vaccine is prepared from the semipurulent discharge of inoculated cowpox in heifers. In a large, shaved, and surgically clean area of the heifer's abdomen, many cuts are made through the outer skin, and into these the infective material is rubbed. Six days later the matter to be used for vaccine is scraped from the resulting lesions; from this matter is prepared the market product. Strict precautions are observed throughout, to prevent a contamination by any infective organisms other than the vaccine parasite.

Bactericidal Sera.—Germicidal sera have been made to produce a passive immunity, but as a rule they do not have the curative power of antitoxic sera; against the germs themselves a passive immunity is produced less readily than against their toxins. Immune serum is effective for killing the germs of epidemic meningitis and those of one type of pneumonia, but for some reason this is not the rule with bacterial infections. Active immunity of a germicidal nature is slowly raised and of great prophylactic value in the many instances just given, but very few of the infections are curable through the use of germicidal sera.

Clear discrimination must be made between the two types of biologic preparations used in specific prophylaxis and therapy. Immune serum contains the antibodies taken from an immunized animal, and is injected to bring about an immediate, though fleeting, passive immunity. To be contrasted with this is the active immunity, brought about by
the human tissues themselves under the spur of inoculated products of the germ.

Chemotherapy.—Most of the animal parasites do not succumb to artificially excited antibodies, though several of them do to certain chemicals which may be introduced to the body with safety. Quinine, in a concentration quite harmless to human tissues, destroys the protozoal parasites of malaria. A few grains of quinine taken daily will protect the tissues from any malaria germs which might enter, and this preventive is recommended to those who travel into malarial regions. Other animal parasites yield to preparations of arsenic, antimony, or ipecac.

A perfectly safe chemical compound may be quite as germicidal as a slightly different one which is highly toxic to the body. Much study is now being centered on the use of complex chemical compounds with such combining power as to unite with and kill germs but not the tissues (chemotherapy).

Protein Sensitization.—Disease phenomena are produced by various proteins in no way associated with parasitism. Certain people have hives (urticaria) after eating a food which contains some particular protein. In some cases the eating of shellfish, in others the eating of other protein foods, causes hives. This condition is to be considered in the chapter on Nutrition. It is an individual hypersensitiveness to a particular protein. The split protein theory outlined in a preceding paragraph was originally applied to phenomena obtained by the use of lifeless proteins.

A hypersensitiveness is produced in guinea-pigs by the injection of such proteins as egg white, or the blood serum of a different species of animal. Injection of a few drops of horse serum would not injure a normal guinea-pig, but it can seriously affect one which has received even $\frac{1}{1000}$ of a drop about ten days previously. After the first injection, the animal might be regarded as having developed ferments capable of breaking down the protein, so that the second dose is immediately broken into poisonous form. An analogous condition in the human is the serum sickness which sometimes results from the injection of an antitoxic horse serum, espe-
cially if serum had been administered previously. Few people, however, suffer from serum sickness and these few with only moderate discomfort. The condition has been serious in so few cases that an anticipation of it should never stand in the way of treatment with antitoxin.

It is only in the exceptionally few individuals that hypersensitiveness of any sort appears; a few acquire a hypersensitiveness to serum or to some other protein, and a few others have naturally a hypersensitiveness to some food.

**Hay Fever.**—Another form of natural hypersensitiveness in man is to certain pollens. This is an inherent trait which gives rise to attacks of hay fever. Symptoms result from a settling on the nasal mucous membrane of some pollen to which the individual is hypersensitive. During the period in which that pollen blows about, sneezing and other symptoms resembling those of a cold continue frequently to recur. These symptoms could be explained as due to the irritating effect on the membrane of a poisonous protein product, split off locally by some tissue ferments peculiar to that person.

Hay fever may result from any of several pollens. Pollens disseminated otherwise than by the wind do not reach the nostrils in appreciable quantity, and these cause the affliction in exceptional cases only. This rules out the possibility of hay fever due to roses, golden rod, and other flowering plants of which insects bear the pollens, though some of these are erroneously thought by many to be the cause of their trouble. Wind pollenized plants are the only real danger. An early spring hay fever has resulted from inhaling the pollen of trees, and the more prevalent late spring hay fever from inhaling that of grasses, particularly timothy. The very prevalent autumn hay fever is caused usually by the pollen of ragweeds.

**Prevention.**—The cutting of grass and weeds as a means of prevention can be made effective only if done very extensively, for the pollens are voluminous and buoyant and are blown over great distances. Victims often seek resorts in the mountains, at the seaside, or in the woods, during the hay fever season, as being free from the plant most troublesome in their particular case. The pollen most troublesome in one section of the country differs from that in another.
Protective inoculations of extracts from the pollens tend to establish temporarily a non-reactive period and to reduce the sensitiveness. This is not an active immunity of the sort established by the injections before mentioned. It avails for only the one season, though it may be successfully repeated each year.

**Reading.*

* General, H. D. Chapin, Chapter IX.
* Infection Through Surface Breaks, Sedgwick, Chapter V.
* Immunity, Jordan, Chapter VIII.
* Local and Focal Infection, Billings, Lecture I.
* Lymphatic Tissue as a Protection, Winslow, Chapter VII.
* Resistance to Parasites, Chandler, Chapter II.
* Protein Fever and Phenomena of Infection, Vaughan, Part III.
* Hay Fever and Allied Conditions, Harvey Lectures, 1915-16, Lecture by W. T. Longcope.

* See bibliography for titles and publishers of books.
CHAPTER V.

REPRODUCTION.

Cell Division.—Tissue grows by the multiplication of its cells. This multiplication is through continually repeated subdivision, each new cell soon reaching the approximate size of the parent cell. In higher forms of life, the cell’s reproductive power lies in the part of its nucleus called chromatin, which is distinguishable from other parts by staining characteristics.

Division begins with a separation of the chromatin into a number of segments, or chromosomes, the number for the cells of any single species being constant. Then the chromosomes all split and thus double in number, allowing a full set for each of two daughter nuclei into which the nucleus divides. Both young nuclei take part of the surrounding protoplasm. Cellular reproduction of this nature is termed asexual, as contrasted with the occasionally intervening sexual cycles to be described presently.

Tissue Balance.—A balance develops between different tissues, such that the cells of one do not overgrow those of another. In general, one organ proceeds no farther in its growth than to a point of greatest usefulness to the others. The many factors behind this balancing of growth are not understood; some seem to be intrinsic and others extrinsic to the cell. In large measure, the characteristics of the whole mass of tissue into which a cell will eventually develop are determined by the nature of its tiny speck of chromatin. Many of the extrinsic influences belong to the subject of nutrition, to be discussed in a later chapter. Some of the internal secretions, poured into the blood stream by certain glands, are also among the influences from outside the cell.

Alteration in the internal secretion of the pituitary body
at the base of the brain causes disproportionate overgrowth of parts of the skeleton, and leads to gigantism. In the testicle or ovary is some tissue (interstitial cells) which supplies an internal secretion necessary for the maturity of the sexual organs and the production of the various male and female characteristics. Such influence on the reproductive power of certain tissues affects their balance with the others, and makes of the body one organized whole.

**Internal Secretions.**—The selective effect on tissue activity is one of many influences which the internal secretions have on the body's mechanism. The secretion of the thymus gland influences greatly the general tissue growth in early years, and that of the thyroid and other glands that throughout life. The circulation of the blood is regulated in part by adrenal and pituitary secretions. Secretions from some islands of cells (islands of Langerhans) in the pancreas cause the conversion of sugar to glycogen, a necessary factor of nutrition.

A deficiency of internal secretion can sometimes be remedied by the administration of corresponding glandular materials from lower animals. Thyroid extract is fed with advantage, and extracts from the adrenal glands, the pituitary body, or the pancreatic islands, are injected. Additional results have been obtained experimentally by transplanting glands from one animal to another; in the case of testicular transplants, practical application has unfortunately gone beyond the experimental promise.

**Tumors.**—The most serious disturbance of tissue balance results when local groups of cells lose the restraint of balancing factors, and proceed to displace other cells. Newgrowths, or tumors, are masses of diseased cells which grow beyond their proper confines. Why they do so is as hard to understand as why the healthy tissue cells do not; the cause of tumors is unknown. The risk of contracting cancer or other tumorous disease is not increased by association with one affected; the disease is not even mildly contagious. Carcinoma, the most menacing of tumors, is unlikely to occur until the latter half of life; the age of greatest susceptibility is from forty-five to sixty-five years.
The benign tumors remain localized in the tissues where they first appear, and do little harm. The cells of the fatal malignant tumors invade many tissues, until one organ after another is involved. Clumps of the malignant cells can be carried by the blood to a distant part of the body, and there take root and grow. The carcinoma is a malignant growth of epithelial cells, and the sarcoma one of other cells. The term cancer is applied to each of these, but more generally to carcinoma. The only cure is by surgical removal of the tumor; every cell growing wild must be included in the tissue taken out. This is possible only in an early stage, before extensive growth has taken place.

Aging of Cells.—The normal reproductive forces of the tissue diminish in power as age advances. The body’s rate of growth declines from birth on. As old age approaches the new cells being formed have smaller nuclei and lower reproductive power than had their distant predecessors. Aged tissue repairs itself more slowly after injury than does younger. Tissue cells are saved from aging to the point of the species’ extinction through the intervention of germ-cells, specialized for species reproduction; the latter are not affected by the aging of their predecessor cells. These can give rise to cells with entirely renewed powers of growth.

Certain of the plants have reproductive spores which develop asexually, but the common type of cell for species reproduction is sexual, both in plants and animals. Half of the chromatin is extruded from the cell, and further reproduction into young tissue takes place only if the full amount is restored by the fusion of another cell with its reduced share. The outgrowth of the fusion of a male and female cell is tissue with fully active reproductive power.

Germ-cells.—Sexual development is not limited to multicellular beings; some of the single-celled animals occasionally pass through a sexual stage in the course of their procreation. The asexual multiplication of the protozoal parasites of malaria is at first rapid, but wanes in a few weeks. Then there come into prominence some sexual cells, also formed in the course of the parasite’s multiplication, which if drawn into a certain kind of mosquito can unite, a male with a female
cell; from the union are evolved cells which have a fully renewed power of growth when introduced by the mosquito’s bite into another person.

Correspondingly, the cells of the human body multiply asexually, though they retain an interdependence unknown to the protozoa. By the end of childhood this asexual development subsides in vigor and about then there begins a formation in the reproductive organs of sexual cells.

**Puberty.**—From the germ-cells in the testicle are formed male cells (*spermatozoa*), which are thrown off by the million. The corresponding female cells (*ova*) are formed in the ovary and thrown off singly. At intervals of about four weeks a blister-like vesicle forms on the ovary, and its rupture releases some fluid which contains the ovum. Each of the two kinds of sexual cells has its chromatin so reduced that only by fusion with the other can it form the number of chromosomes required in the human species for cellular reproduction. Each holds in its share of the chromosomes determinants of the parent body’s characteristics, deriving them from the preceding generations of germ cells which had given rise to that parent body.

The ovary continues to form sexual cells for about thirty years, the testicle throughout life. The beginning of this sexual activity, or *puberty*, is marked by obvious changes in the body. The male voice changes its pitch, and a beard begins to grow. Even more definite changes appear in the female. Puberty occurs at about the fourteenth year, somewhat earlier in southern than northern peoples.

**Menstruation.**—The most definite sign of puberty in the female is the beginning of menstruation. A period is associated with each monthly liberation of an ovum. It is a result of the uterine mucous membrane having undergone congestive changes suitable to the nourishment of the ovum, had the fusion with a male cell taken place. When the ovum is not fertilized, the congested vessels break and some four to eight ounces of blood escape.

The headache, depression, and other occasional symptoms are due not to the blood lost, but to other effects of the ovarian activity. The period should never cause very marked
disturbance, and if it does the probability arises of some physical disorder. Pain during menstruation (dysmenorrhea) is predisposed to sometimes by pelvic trouble. It is the more likely to occur after carelessness about exertion, chilling or constipation. The healthy girl can continue her daily routine of exercise and bath, but may feel adversely the effects of too strenuous exertion, or of a bath which is too hot or too cold.

Female Genital Tract.—Malposition of the uterus in the pelvis is one cause of menstrual disturbance; it also may cause backache and perhaps irritability of the bladder or other symptoms. An abnormal position of the uterus does not necessarily cause disturbance, and unless it does calls for no treatment. Malposition can result from congenital defect, from childbirth, or from excessive strains involving abdominal pressure.

At the inner end of the uterus are connected two tubes (Fallopian tubes) which are open at their further end to receive from the two respective ovaries the ova. It is usually in these tubes that the ova are fertilized, the male cells from the outer passage having entered and made their way through the uterus.

Male Genital Tract.—The male genital tract includes the two testicles, and connecting with each a tube (vas deferens) to carry the spermatozoa toward the exterior. At a place in the groin the tubes lie just beneath the skin. An operation, which consists simply in breaking the continuity of the tubes here (vasectomy) is used to prevent males with hereditary criminal tendencies from having offspring.

Before the spermatozoa leave the genital passageway, there is mixed with them a secretion from the prostate gland, which increases their motility and aids any migrations toward the ova. An emission of such secretion (semen) also occurs at times during sleep, quite independently of sexual practices, a normal occurrence of no hygienic significance.

Pregnancy.—When an ovum is fertilized by a male cell, it implants itself in the mucous membrane of the uterus, where warmth and nourishment enable it to pass the early stages of cellular multiplication. Only after nine months'
growth can the tissues of the baby develop independently of those of the mother. Placental tissues of mother and of baby are in contact and permit an interchange of fluids from the blood stream of the one to that of the other. All tissues of the two are distinct, and except at the placenta are separated, throughout pregnancy. The supposition of a prenatal influence on the baby of the mother's thoughts or experiences is entirely without basis, for no determinant of a bodily peculiarity could possibly be dissolved in the body fluids, and there is no other means of communication between the two.

Proper medical attention during this period of pregnancy is conducive to the welfare of both, though in general the mother's mode of life need not be changed. Moderate exercise may be continued, but not overexertion or heavy lifting. The periods allowed for rest should be made sufficient for avoidance of fatigue. The diet is regulated to prevent constipation or any considerable increase in weight. Solid diet is continued; symptoms of nausea are aggravated less by it than by a soft or liquid one. The teeth tend to become carious, due to the baby's heavy demand for calcium, and should be put in order early in pregnancy and regularly cared for; the calcium and vitamins of the diet are not to be neglected. It is best to remain under a physician's supervision throughout, as some unsuspected ailment might interfere with the pregnancy, or some such complication as nephritis might result from it.

Child-birth.—The extent to which preventable ailments have attended child-birth lends emphasis to the urgency of competent medical attendance. The attention of a meagerly trained midwife is a very poor substitute, and fortunately this is being more and more generally realized. Accidents of delivery endanger both baby and mother. One danger is that of a pelvis so deformed as to hinder the birth of a child through it; the physician would look into this possibility early in pregnancy.

The most prevalent of the serious infections which attack the child during birth is gonorrheal ophthalmia, which leads often to blindness. In order to reach all babies which might be exposed to this infection, many States have the wisdom
to require that antiseptic drops be put in the eyes of every baby born. The tuberculosis hazard begins immediately after birth, and babies should not be left in the care of actively tuberculous mothers. The syphilitic mother, on the other hand, could safely care for her child, as any transmission of her infection would have been before birth.

**Marriage.**—More of the congenital diseases are transmitted long before than at the time of birth; some begin at the time of conception.

The congenital disease is any that the parent transmits to a child at or before its birth. It may be hereditary or it may be an infectious disease transmitted through the placenta during pregnancy. Long-standing alcoholism of the parents leaves its imprint on the child’s health, due probably to defective nourishment through the placenta.

The control of congenital disease is possible in large measure through suitable marriage. Not only the hereditary diseases, but such communicable ones as syphilis and tuberculosis frequently enter the family at marriage. A preliminary health certificate sought in good faith by all parties is a wise safeguard against many such diseases. As a general compulsory measure its value is limited by the examinee's opportunities for dissimulation. From physical signs and laboratory test alone, the physician cannot always detect an infection which is carried or mildly suffered, nor can he ascertain the hereditary traits in a family unless its history is truthfully presented.

**Hereditary Disease.**—The hereditary disease begins at the time of conception, when the male and female cells first unite. Among the hereditary defects are some gross deformities, certain disorders of the eye, the “bleeder” condition (*hemophilia*) and some nervous and mental diseases and deficiencies. All do not follow the same rules of transmission. The condition of the bleeder or color blind person is sex-linked in transmission; the inherited trait does not equally affect both sexes. In many cases the mode of inheritance is not understood. Generally, the determinants of hereditary disease proceed not from one but from both of the parents. The disease is a defective trait, transmitted just as many other traits are, in accordance with Mendel’s law.
Mendelian Inheritance.—Where traits inherited from the two parents are antagonistic and cannot both characterize the offspring, only the predominant of the two reveals itself. The other is hidden (recessive) but is nevertheless present and still transmissible. Parents, the one perfectly sound in some given respect and the other quite defective in this respect, pass to each child both the sound and the defective traits. This may be diagrammed as in Fig. 12.

![Diagram of Mendelian Inheritance](image)

None of the children prove to be defective, assuming for the present that the sound trait predominates and the defective trait is recessive, as only the dominant trait appears. A producer of hereditary disease is present, but it is so well resisted by the accompanying sound trait that no disease results. Such a person, on becoming a parent, could transmit either trait; four children might be endowed as in Fig. 13. This is purely a chance distribution, just as pairs of cards drawn one from each of two decks are equally likely to be two red cards, a red and a black, a black and a red, or two black. Three-fourths of the children indicated in Fig. 13 have either
sound traits only, or sound traits to resist and prevent any evidence of the coexisting defective traits; the remaining one-fourth is frankly defective. If the trait of disease here were dominant instead of recessive, the three-fourths would inherit its evidences; there would not be the inherited resistance.

An important consideration is that one whose near relative has an inheritable defect cannot always be sure that he also does not have it hidden away; if not dominant in type it may be present in him and transmissible, though not evident. His children can develop this disease, however, only if the other parent’s family runs the same trait. The danger to offspring from a marriage of cousins or of other closely related persons is that any defective trait carried by the one is as likely to be carried by the other too.

Dominant traits may lead to certain deformities of the extremities, to bony fragility, to presenile cataract, and to chronic chorea (Huntington’s). On the other hand, traits must be inherited through both parents to be capable of causing albinism, feeble mindedness, retinitis pigmentosa, hemophilia, and color blindness. In the case of many inheritable human traits dominance is not clear. Suitable selections for marriage are such that both of the families do not carry any hereditary defective trait, and that neither party shows the effect of a defective trait known to be dominant. This protects the following generation from the bad qualities transmissible through inheritance.

**Prevention of Conception.**—The ultimate wiping out of hereditary inferiority is to be accomplished only through an overgrowth of the less gifted classes by the more gifted, a matter of relative rapidity of procreation. Mental inferiority seems to be one of the traits most menacing to the race because there is at present little promise of its being overgrown. Those with high-grade mentality have much smaller average families than do the poorly endowed, and it is the latter who are providing for the eventual survival of their kind. A much neglected responsibility of intellectual people is that of carrying on their inheritance to future generations. This hazard has been increased by widespread prevention of
conception among certain sorts of educated people, unheedful that successors will be as much needed as are they in the world. The practice is less reprehensible than that of infanticide or of criminal abortion, but its effect on the race is the same.

The recent movement to make such a practice available equally to the untutored would, on the other hand, serve to reduce incompetence in future generations. Some of the authorities on eugenics and social uplift have advocated this. Many would fully enlighten everyone on all sex processes, and their control.

**Sex Education.**—Others hesitate to go so far with sex education, though it is clear that people should know more about sexual and venereal problems than they now do. The better understanding of these problems spread among college students of recent years has definitely reduced the prevalence of venereal disease. Information acquired by the students from companions has been mingled, however, with much misinformation. No one doubts the superiority of systematic teaching over this haphazard acquisition of information.

The only phase of sex education which has had proper attention until recently is the moral one which enters into religious training. The influence of the churches has promoted such organization of the mind as to bring impulses of sex closer to family sentiment; it has resisted licence, masturbation, or day dreaming over sexual matters, with their attendant hazards to health. It covers only part of the problem at best, however, and does not reach half of the people at all. A helpful and correct understanding of sex hygiene can be given to the masses only through the school system. This would not replace but would extensively supplement the moral training. The subject is best taught to classes for boys and for girls separately, a little before the age of puberty is reached.

As a preliminary to the teaching of sex, both the lower grades and the home can enlighten on the general scheme of reproduction. Life histories of plants make interesting stories, and even for little children may include the sexual process of pollination. The evolvement of the butterfly,
through fertilized egg, caterpillar, and cocoon, can follow, and later that of some higher forms of life. The growth is always traced along from the two sexual cells. The child comes to think correctly instead of imperfectly and suggestively of reproduction. The venereal hazards can wait for the formal instruction on sex.

**Venereal Disease.**—Venereal diseases are those especially prone to be contracted through sexual contact with an infected person. There are several of them, of which two, syphilis and gonorrhea, are quite serious. The former creates the greater havoc to the tissues and functions of the body; the latter is the more widespread. Syphilitic infection ordinarily enters through an abrasion, most often in the mucous membrane but sometimes in the skin. Infection requires so little abrasion that an average moist membrane is hardly a barrier at all. Gonorrheal infection attacks only the mucous membrane, but does not require any abrasion whatever.

**Germ of Syphilis.**—The germ of syphilis (*Treponema pallidum: Spirochaeta pallida*) is one of a group of long spiral parasites lying close to the animal kingdom, or possibly in it. The germs are killed by a few hours’ cooling to room temperature, and much more quickly by drying. Any which have been carried away from human tissues are not a menace, even during the short remainder of their life. Many authorities are dissatisfied with the evidence which suggests a transmission of syphilis by drinking cups, towels, and other lifeless objects, though such transmission to a person who uses the articles immediately after the patient does would not seem to be impossible. Practically, transmission requires immediate transfer to an abrasion on the recipient of some infected body fluid from the syphilitic person.

The infected spot inflames after a few weeks into the characteristic hard chancre (*primary stage of syphilis*). General symptoms (*secondary stage*), including fever, aching, and rash, appear several weeks later. The germs have by then accumulated and are being combated by the immune bodies. At this stage the disease is more highly infective than at any other period. The spirochetes die off largely after a
few more weeks, but scattered tissues continue to breed them and react with a type of inflammation called the gumma (tertiary stage). A still later stage involves parts of the brain or spinal cord, leading in the one case to a form of insanity (general paresis), and in the other to a permanent muscular incoördination (locomotor ataxia: tabes dorsalis).

Infection is usually by contact involving the genital mucous membrane. The disease is kept alive and disseminated through promiscuous sexual habits. Half of all people infected are innocent of such habits, however. This latter half are infected through family relations, or through the so-called accidental infections independent of sexual contact. Anyone might get some infected blood into a skin abrasion while giving to a syphilitic person the first aid for a bleeding wound. Saliva commonly transmits syphilis to those with cracked lips, through kissing. Popular prejudice against smallpox vaccination has sometimes fallen into the argument that syphilis can thereby be conveyed; rare instances may have occurred formerly when vaccinations were made with scabs from previously vaccinated persons, but the possibility is entirely precluded by the cattle lymph method now in general use.

Family Infection.—Closest associations mean greatest exposure to syphilis, and the members of the patient's immediate family suffer most. When any member of a family is found to have syphilis, the others should be examined for it by laboratory test (Wassermann reaction), for they may have been infected without realizing it; the clinical picture is not always typical. Wives commonly become infected from their husbands; while infected they may have babies which contract the disease even before their birth, through placental infection.

The responsibility for preventing a spread of the infection through the family rests with the patient; those of them with any principle at all live up to it. Part of the medical advice given to syphilitic persons concerns the protection of others. The disease is curable, entirely in most cases and to the point of non-infectivity in the rest, though many months or even years must sometimes be devoted to the cure.
Congenital Syphilis. — Congenital syphilis, acquired by babies before their birth, is from an infected mother. The probability of a prenatally transmitted infection, and the severity of one if acquired, depends on the degree of infectivity of the mother's body fluids. An untreated infection in the secondary stage would almost surely be transmitted to the child; the probability decreases with the lapse of time since this stage. Active treatment greatly reduces the infectivity of the body fluids, and if continued throughout pregnancy gives the child a chance for healthy birth.

Heavily infected babies die before or shortly after birth. The more mildly infected develop symptoms usually within a few weeks. The baby then becomes irritable and loses weight; its nose runs, cracks and lesions appear on the mucous membrane of the mouth, and the skin breaks out with various forms of rash. A later stage involves fairly characteristic deformities of the teeth, stunted growth and changes in bones, eyes and ears. Sometimes the disease does not become evident until late in childhood.

The acute symptoms of infancy mark the very infective stage of congenital syphilis. Healthy wet nurses who nurse syphilitic babies are in danger, and such babies are often too delicate to thrive except on breast milk. The nurse's health should be guarded by pumping the breasts and then feeding the milk to the baby from a bottle. Conversely, syphilitic wet nurses endanger healthy babies; wet nurses should be employed only after a Wassermann test has indicated their freedom from the disease. As the little patient outgrows babyhood, the danger subsides of a transmission of its infection to others, and after early childhood this danger is practically nil.

Gonorrhea.—The germ of the other venereal disease mentioned is a pus producing bacterium (gonococcus), the cells of which appear under the microscope as pairs of somewhat flattened spheres. This germ attacks most readily the membrane covering the front of the eye and that lining the genital tract. The conjunctiva is exceedingly susceptible, and the infection spreads rapidly over it. The membrane of the genital tract offers somewhat more resistance and
the infection limits itself as a rule to the area near the exterior.

Not infrequently, however, the infection spreads over the entire membrane and involves all the genital passageways; the only organ to escape is the testicle or ovary. Some of the organs are likely to remain chronically infected, unless the disease is actively and skillfully treated; the infected person continues for a long period to be infective to others. Prostitutes nearly always harbor an infection, which they have acquired at some previous time; they are always dangerous as transmitters of this disease and of syphilis.

Sequelæ. — The final result of a gonorrheal infection may be small or great according to the extent of the inflammation. Invasion of the underlying tissue occurs, which in the case of the eye leads often to blindness and in that of the genital tract to an extensive formation of scar tissue. Sterility of either male or female occurs, due to an obliteration of passages by the scars or to other injury. The gonococcus can also be transported through the blood stream to other tissues and set up complications in joints, heart, or other organs. Cases of gonorrheal rheumatism are frequently encountered by physicians; this complication resists treatment and is overcome with difficulty.

Prevention. — Prevention of gonorrhea is by the avoidance of gonorrheal discharges. The pus may be regarded as dangerous until it dries, or for possibly as long as a day. The germ is much shorter lived than most other pus bacteria, but it does not die off as soon after leaving the body as does the germ of syphilis.

Generally effective measures for preventing the infection, after gonorrheal contact, consist in the thorough flooding of the exposed part of the membrane with one of the silver antisepsics. The eye membrane or the genital membrane should be so treated immediately, if there is any suspicion whatever that gonorrheal pus may have reached it. The treatment is to be given very thoroughly and wherever possible by a physician.

Accidental Infections. — The usual forms of gonorrhea transmitted otherwise than through sexual contact are conjunc-
tival infections (gonorrheal ophthalmia), and genital infections in little girls (vulvovaginitis of children). Public toilets often are reported to cause genital infections in adults, but such claims are made for the avoidance of embarrassing admissions. A dirty toilet might conceivably transmit gonorrhea, as well as typhoid fever and other infections, but the danger is slight.

Gonorrheal ophthalmia has already had brief mention. It follows a conveyance of gonorrheal pus to the eye, by contaminated hands, towels, etc. Those who care for a patient with any type of gonorrhea should use particular care not to infect their own eyes. If pus is known to reach the eye, argyrol is immediately to be dropped in; but a physician should be seen too. After this infection develops, only the most careful treatment can save the eyes.

**Vulvovaginitis.**—Genital membranes of girls under five are infected by the pus from diseased mothers or attendants; this occurs so frequently that many institutions make a routine laboratory examination of every girl admitted, in order to avoid the introduction and spread of the disease among their young inmates. Institutional epidemics have sometimes been controlled with great difficulty; the germ is readily transmitted by articles used in common, and is carried by convalescents for a long time.

An infected child in the household should always be isolated from the non-infected until cured. Even after apparent cure and repeatedly negative laboratory test, the case is liable to relapse. Clothing and other articles used by the patient should be kept to themselves when dirty, and thoroughly cleaned or where possible boiled before coming into contact with those used for others. Attendants should wash thoroughly after handling the patient.

Transmission is more likely to result from thoughtless neglect of precautions than from faults in the precautions employed, for it is not hard to destroy these germs when away from the body. Adult patients and their attendants should be equally cautious to avoid further transmission, and should keep in mind constantly the two routes of accidental infection.
Leucorrhea.—Chronic vaginal discharge, usually of a whitish appearance and therefore called *leucorrhea*, is not uncommon. It is largely a product of uterine or vaginal glands, excited by gonorrhea or other irritative condition. An inoffensive discharge in girls might indicate the vulvo-vaginitis just described, or masturbation, or an infestation with pinworms. Pregnancy leads to some discharge, as might also uterine malposition or defect, or a congestion due to systemic infectious disease. A bad odor suggests that the discharge has been retained for some time or that it is associated with decay of tissue. A very offensive or bloody discharge during middle or advanced age is suggestive of cancer; after reaching any considerable size the cancerous tissue decays, as the center cannot get nourishment at its distance from the blood supply. Leucorrhea is always a symptom which bears investigation.

**Reading.*

*General, J. F. Williams, Chapter XII.*

*Sex Hygiene and Disease, Winslow, Chapter IX.*

*Healthy Parents, Scurfield, Chapter I.*

*Inheritance of Disease, Rosenau, Section IV, Chapter III.*

*Eugenics and Inheritance, Fisher and Fisk, Supplementary Notes, Section IX.*

*Sex Education, Rapeer, Chapter XXIX.*

*Venereal Disease, Lee, Chapter XIV.*

*See bibliography for titles and publishers of books.*
CHAPTER VI.

THE DIGESTIVE SYSTEM.

Digestion of Foods.—The alimentary system digests and passes into the tissues the nutritious portion of articles ingested. Both animal and vegetable food contains, besides the nourishing food elements, much water and non-nutritious bulk. This is first crushed with more water into a thick fluid (chyme), for which purpose it is chewed and then churned about by muscular activity in the gastro-intestinal tract. The tract then proceeds, by means of ferments poured from glands into the food mixture, to change the nutritious matter chemically into suitable form for the tissues’ use. The digested nutritious substance, dissolved in the water present, is finally absorbed through the mucous membrane into vessels which distribute it to the tissues.

Peritoneum.—The gastro-intestinal tract is held in place by a membranous sheet, consisting principally of a strong feltwork of fibrous tissue. This membrane (peritoneum) is in many respects unlike the mucous membrane described in an earlier chapter. Large, flat cells cover it and give it a smooth and glistening surface. It lines the abdominal cavity, from the posterior wall of which it is slung forward to fold around the gastro-intestinal tube and double on itself back to the abdominal wall. The bowel is thereby furnished a firm hanging support, and yet retains freedom for muscular activity. Other abdominal organs are similarly suspended.

If hereditary defect renders the support too loose, the viscera gravitate toward the bottom of the cavity (viscerop-tosis). Most of the attempts at surgical correction of this condition have been unsuccessful; a properly adjusted abdominal supporter offers greater relief, though not a cure of course.

Adhesions.—Abdominal inflammations, as for instance chronic appendicitis, operative wounds, or other scar-pro-
ducing injuries, may cause parts of the peritoneal sheet to adhere together. Such adhesions have caused kinking and even obstruction of the bowel, but this is rare. Most adhesions are harmless. As a rule no symptoms result, though occasionally dull pains and drawing sensations may be felt. Most of these cases that give trouble cannot be cured surgically, because new raw surfaces left by the operation would only give rise to more scar formation. Mild symptoms from adhesions are best disregarded.

Hernia.—The openings about structures that pierce the lower abdominal wall are normally closed by the peritoneum and other fascial support. In some persons the closure is faulty, and this permits a loop of bowel to work its way through the opening (hernia: rupture). The condition is not due primarily to any strain which might first force the bowel through, but to the inherent defect. It can be corrected surgically, and in most cases of pronounced hernia the operation is advisable. Hernia might also occur through an old operative wound, particularly if long drainage of pus through the wound was necessary.

The greatest danger from hernia is strangulation; tissues about the opening close in on the loop of bowel and shut off its circulation. This is followed by intense pain in the region, a symptom which calls for immediate surgical care; delay of the operation for strangulation, even for a day or so, would probably cost the patient his life.

Structure of the Tract.—The peritoneal membrane forms the outermost of four coats making up the gastro-intestinal tube. The innermost is the mucous membrane through which the dissolved foods are absorbed. Next to this is a coat of loose fibrous tissue (submucous coat), which contains small vessels to collect the absorbed material and pass it on to larger vessels for distribution. Between the submucous coat and the peritoneal covering is the coat of muscles, the churning activity of which has been mentioned.

Parts of the tract specialize for the respective steps of the digestive function. Strong muscular rings (sphincters) divide the tube into sections, each of which qualifies for a stage of the process. The first ring (cardiac sphincter) sepa-
rates the esophagus from the rest. Another (pyloric sphincter) develops farther down, and the tube between these two rings enlarges into the stomach. The tube below the latter ring constitutes the bowel or intestine. A third ring (ileo-colic sphincter, at the ileo-cecal valve of the mucous membrane) divides the bowel into two sections. The first section lengthens greatly into the small bowel. The lower section enlarges and lengthens into the large bowel or colon. A final ring (anal sphincter) closes the end of the tube.

**Esophagus.**—The first section of the tract, the esophagus or gullet, serves only to bring food and water to the stomach. Solids are forced along by muscular action. Such action here or elsewhere in the tract is termed peristalsis. Peristaltic waves are muscular constrictions, which in the esophagus begin with the voluntary contraction of the muscles of the throat and pass downward to the cardiac ring; the latter relaxes to admit the food into the stomach. The esophagus has no peristalsis in the reverse direction; the force of vomiting is entirely from contraction of the stomach and abdominal muscles.
The horse and other animals which drink upward have water carried to the stomach by peristaltic waves, but in man liquids simply gravitate downward after being started by the throat muscles. Drinking with the mouth half full of solid food, for which children are so often reproved, hinders the throat muscles from properly starting the activity; it is this that sometimes causes the fluids to gravitate into the windpipe.

**Belching.**—Some people swallow too much air and as a result habitually belch. Sometimes a little more air is swallowed in the motion of belching, and then this is belched up, so that the repeated action runs into a series. Neither this habit nor the presence of gas or air in the gastro-intestinal tract is particularly suggestive of any fermentative disorder; the latter may cause belching, but does so less often than does the swallowing of air. A quantity of gas or air is present in the tract normally, and the habit of swallowing merely augments the amount; no harm is done.

**Foreign Bodies.**—Fish bones or other small objects swallowed are likely to do all their damage before they reach the stomach. Removal by surgical instruments is occasionally necessary when they stick in the esophagus, though usually a big swallow of food or water will take them past the danger zone. An object which sticks in the throat of a child can usually be hooked out with the finger. The finger should be carefully worked around and behind it, so as not to force it into the windpipe. The manipulator's hand is protected if the child's cheek is pressed in between its teeth. Objects will often drop out if the child is held upside down by the legs and pounded on the back to start coughing.

**Stomach and Intestine.**—In the stomach, food collects and receives a portion of the digestive juices. The upper and more dilated part of the stomach (fundus) holds the material and feeds it gradually into the lower part, or pylorus, which is more constricted and muscular. Peristaltic waves, which keep driving down against the closed pyloric ring, crush together the food and water in the pylorus. As digestive juices have also been poured in, the food mixture becomes a thick and partly digested fluid. Hydrochloric acid, from
some of the secreting cells of the stomach, plays a part in the digestion of protein foods and in the closure and opening of the pyloric ring. The ring opens at intervals and lets part of the mass into the small bowel for further digestion and absorption.

The muscular coat of the tube provides the movements for stirring up and pushing along the food matter. There is a circular layer of muscle, and outside this another layer directed lengthwise; their contraction squeezes in on the tube and pulls the constrictions along. Types of peristalsis in the esophagus and stomach have been mentioned. The small intestine has two types of peristaltic action, one of which consists in simply squeezing at one place and then another, and the other in having the constrictions pulled for a short distance down the tube. A third form, which sweeps the entire length of the bowel, occurs only in abnormal diarrheal conditions.

The peristaltic action of the muscles is in response to nervous stimulation, mainly through networks of nerves. One such network (Auerbach's plexus) is between, and another (Meissner's plexus) just within the two muscle layers. Sensory elements about the mucous membrane communicate with them. Substances within the tube stimulate these nerves mechanically and chemically and bring about the contractions. In this way, the food mass itself institutes such muscular activity as will mix it and force it along the tube.

There are also connections with the general nervous system of the body. This permits mental conditions to influence the digestive activity. Strong emotions definitely interfere. Worry, fear or anger may inhibit the contraction of the stomach and spoil the appetite. They also cause constipation, and terror may cause diarrhea. The favorable effect on the digestive processes of an after-dinner smoke is due in part to a soothing of emotion, though there is also a direct stimulation of the taste nerves which would play some part.

Feeding Habits.—The various digestive activities are so correlated that one stimulates another to action. The taste
of food in the mouth reacts to produce digestive secretions in the stomach. The whole process is thereby set in motion. Haste in swallowing food reduces the primary taste stimulus, whereas leisurely eating with slow mastication acts more favorably. It is unlikely that this favorable influence is due entirely to the more complete maceration of the foods, as has often been assumed. Music at meal time promotes a tendency to relax and eat slowly, and to this extent aids digestion.

The digestive activity is favored also by regularity of habit. Regular hours for meals mean better appetites. Babies fed irregularly, according to when they wake up or when they cry, have the discomfort of irregularly timed hunger pains. They do better if fed on a regular schedule. The digestive tract needs regular periods of rest between successive feedings. These should be not less than four hours, as a rule, even for babies. Eating between meals or too frequently spoils the appetite and produces in many persons unpleasant symptoms.

Dyspeptic Symptoms.—The uncomfortable, sour, and heavy feeling sometimes called indigestion or dyspepsia indicates some physical disorder. The symptom does not, however, tell what part of the body is disordered. It may result from tooth or tonsil disease, from stomach ailments of one kind or another, from constipation, or from improper diet or too rapid eating. It may even result from disorders entirely foreign to the tract, such as mental or cardiac trouble. As a danger sign, this symptom is therefore of very limited value; it does not locate the danger, which frequently is hardly enough to justify diligent search. The management depends on what other symptoms and signs accompany it. Temporary relief is often obtained by taking a little baking soda.

Fancy diets tax the digestive function of some persons and cause dyspeptic symptoms. So do highly spiced foods; spices and condiments are sometimes thought to irritate the mucous membrane and thus alter the secretions. Fried and greasy foods are often troublesome, perhaps because the fats coat over and withhold the food temporarily from digestive juices. It is manifestly unwise for persons so troubled
to continue this sort of diet. Very hot or very cold foods, or hasty eating, can provoke symptoms.

**Dietetic Fads.**—Within the limit of the nutritional requirements to be outlined presently, there would seem to be no reason for condemning any of the dietetic mixtures which do not produce dyspeptic or other symptoms. Many popular fads concerning diet are quite devoid of foundation. Grounds for the widespread fear of milk in combination with shellfish or fish are principally imaginative; ill-effects from contaminated shellfish, or possibly from the eating of shellfish by hypersensitive persons, may have contributed to the superstition. Acid foods served with milk foods have been objected to on the theoretical ground that milk curdles with acid; the fallacy is obvious when one remembers that milk is expected to curdle before digestion anyway, and that except in babies it would do so from the acid of the stomach. Acid and alkaline drinks are criticized because they alter the stomach’s acidity, but while acid is required for peptic action on meats its exact concentration is of no importance; some persons in apparent health have acidity much above the average and others much below. Drinking of water with meals is objected to, but as a matter of fact digestion proceeds much better if a lot of water is mixed with the foods; unless the water serves to wash down the foods and hasten the eating it does no harm.

**Digestive Juices.**—The first trace of digestive activity is that of saliva on the starches. No considerable degree of digestion takes place until other juices have been added in the stomach. The final quota of juices reaches the mass in the first part of the small intestine. The sources of digestive juice are secreting cells, derived from the epithelium within the tract. Some of the cells are in the membrane of the stomach, others in that of the intestine, and others in distinct glands which have developed from outgrowths of epithelium. Such glands are those about the mouth which secrete saliva, and that in the abdomen known as the pancreas. The latter is a large gland which empties its juice through a duct into the small intestine. Bile enters at the same place from the liver, and while not itself digestive it aids the activity of digestive juices.
The digestive glands and the liver require no attention to keep them active, other than general alimentary hygiene. So-called liver medicines have often been employed by constipated persons to correct that organ's supposed sluggishness, but the liver is not the organ affected by these medicines nor was its sluggishness a cause for the constipation. Constipation will be considered shortly. The action of the respective juices will be explained later in connection with foods and nutrition.

**Bacterial Flora.**—The question has been raised as to whether ferments from bacteria may not also aid in the digestion of foods. The bowel contents swarm with bacteria, of which many secrete ferments capable of acting on the food matter about them. These bacterial ferments have sometimes been thought necessary to the digestive function; the evidence is conflicting. At all events these bacteria are in no sense harmful, and nothing would be gained by the routine taking of so-called intestinal antiseptics, even if they worked. Only rarely, in the physician's management of certain disorders, is antisepsis of the bowel to be desired.

**Absorption.**—When foods have finally been digested, the mucous membrane of the small bowel absorbs them and passes them through to the vessels beneath. Some epithelial cells of the membrane have the specialized function of taking in the nourishing solutions; this is facilitated by the normal peristaltic action, which moves the mass slowly along and keeps squeezing the membrane into it. The small blood- and chyle vessels, which richly supply the submucous coat, send tributaries to the epithelial cells of the mucous membrane to collect the absorbed material.

Foods other than fats are passed directly to small bloodvessels. The fatty matter absorbed, called chyle, passes into the chyle vessels, which form part of the lymph vessel system. Smaller chyle vessels converge into the larger, and the last empty into the large veins. Through these channels all the food absorbed gets to the blood stream and is distributed to the tissues.

**Blood Supply.**—The intestine uses an especially full supply of blood during the process of digestion. This should be
carefully provided for in the case of underweight persons or those having some other physical defect. The malnourished are benefited by lying down for an hour or two after meals, so as not to draw away the blood to working muscles. Any persons with circulatory defects might well abstain from bathing or swimming during this period of digestion, as such interference with the distribution of blood could easily strain the circulation.

The work of the brain does not draw actively on the blood supply of other organs, but must get along with what they are not using; great accumulation of blood for digestive purposes therefore draws blood from the brain and retards mental activity. On a hot day, when the skin is also drawing on the blood supply, a drowsiness and lagging of mental activity is quite likely to follow a heavy meal. Many take their heaviest meal at night in order to permit closer mental application during the early afternoon.

Absorption of Chemicals.—The membrane which absorbs food to the blood stream can absorb simpler chemical solutions too, in many instances much more readily. The absorption of medicinal drugs is an instance, as unfortunately is also that of chemical poisons. The importance of teaching children to recognize and avoid poison bottles is obvious. Swallowing of poisons by adults is more often by accident than through ignorance of the danger; carelessness about labelling or reading the labels is often at fault. Proper labelling of home-made solutions is very often neglected, and poison labelled by the druggist is taken in the dark. Such carelessness has led to many deaths.

Dishonest labelling is a factor in the patent medicine hazard to health. Mixtures which contain stimulants to exhilarate the victim or other drugs to deaden his sensibilities alleviate discomfort only temporarily, but their labels and advertisements are so worded as to suggest a permanent relief. False hopes are given to unfortunates who might otherwise accept what aid medical care can give and use their own resources to some advantage. What medicinal activity the patent medicine has at the seat of injury is often detrimental rather than helpful. A large number contain cathartic drugs which aggravate a constipation and make the complaint worse.
First Aid to the Poisoned.—Every one should know how to manage cases of accidental poisoning, for often a patient must be either saved or lost before a doctor can be reached. First aid consists in immediately giving an antidote, and then, except for mineral acid or alkali, emptying the digestive tract. Vomiting may be induced by a drink of warm mustard water—a tablespoonful of mustard to a glass of warm water. After the stomach has emptied itself and quieted down, an active cathartic should be given. Taking of the antidote may be repeated occasionally throughout the rest of the process. Except in the case of opium poisoning, the patient is to be kept warm, rested, and given plenty of water.

It is hardly worth while for average people to learn what antidotes they might get from the druggist, because the druggist would know which is best for the case in hand. It is decidedly worth while to know what antidotes are in the kitchen, which is so much nearer than the drug store. Mineral acid poisoning may be treated by the eating of soap; a few teaspoons of magnesia is better, but this is not often at hand. Soda is not a safe antidote for acids taken internally, as the gas liberated would tear the eroded tissues. Lye or other alkalis are neutralized by dilute vinegar. For heavy metal salts, such as mercury bichloride and arsenic preparations, milk or egg albumen is given. Strong tea binds and makes harmless the alkaloidal drugs, such as strychnine, atropine, and many others with a name ending in "ine." Starch binds iodine; while preferable cooked, it is better to give it raw than to wait for cooking. Carbolic acid is best counteracted by an alcoholic drink, if a stomach tube is available for cleaning out the stomach—the most important item in this instance—though not otherwise. Chalk or plaster is used for oxalic acid, soda for the coal tar drugs in headache powders, and strong tea or coffee after morphine or other opiates. In the case of opium poisoning, the patient is to be kept aroused and awake at any cost. In any case of poisoning one should work fast; deliberation is likely to prove more costly than minor mistakes.

Bacterial Food Poisoning.—Food poisoning is a general term applied to any of several acute disturbances which result
from the ingestion of unwholesome food preparations. The term ptomain poisoning is often used as a synonym, though properly this term should be restricted to the rare cases of poisoning with certain protein decomposition products called ptomains. Bacterial poisoning of foods is principally of two types, acute enteritis and botulism.

The commonest type of poisoning is one of the food-borne infections; the other food-borne infections are not popularly termed poisoning and are not included. This form of "poisoning" is an enteritis, often suffered epidemically by several persons who have eaten together. An acute diarrhea with vomiting, abdominal cramps, and some feverishness, follows the feast usually by something less than a day. This is due to an intestinal infection by certain bacteria (Gärtners and allied bacilli). The bacteria reach the food occasionally as a contamination, during or before preparation, but more commonly as an infection of the animal slaughtered for food. The germs are not readily destroyed even by heat, and to be safe the infective meat must be cooked until well done throughout.

Botulism.—Botulism is poisoning due to one of the bacterial toxins (of Bacillus botulinus); this is the only bacterial toxin which has been shown to be poisonous when taken by mouth. The bacterium enters canned or preserved foods through dirty handling by canners; as its growth requires no oxygen, it continues to multiply in the sealed receptacle and to throw off into the food its toxin. The symptoms are nervous rather than intestinal. Instead of diarrhea and cramps, dizziness is complained of, with nausea, difficulty in eating, and marked prostration. Double vision, dilation of the pupil, and drooping of the lids occurs. This is much more serious than the other type of bacterial poisoning, and is often fatal. Cleanliness in putting up foods is a preventive, as is also the heating to an almost boiling temperature—above 80° C or 176° F. for half an hour—before serving; this degree of heat breaks down the toxin. If canned goods that smell or taste somewhat spoiled are to be eaten at all, it is safer to heat them first.

Other Food Poisoning.—A few naturally poisonous substances closely resemble foods and therefore lead to poisoning.
Several poisonous plants and certain poisonous fish resemble edible articles, though most of them are unlikely to be offered for food in this country. Poisonings with marked nervous involvement have occurred from eating mushrooms. Mushrooms should be collected only by those who are able to distinguish wholesome varieties from those which contain muscarine and other poisons. The poisoning of foods by metallic products from pots and pans occurs less often than was formerly thought; many apparent cases of this are really food infections.

The preservative addition of those antiseptics which the authorities condemn as injurious might almost be classed with the criminal poisoning of foods, but it occurs. In some localities the treatment of market milk with formalin to delay souring is widely practised, and for babies or possibly some older persons such milk is not always harmless; heating in a pan rids milk of the bacterial danger but a chemical poison in milk is beyond correction. Such preservatives as benzoate of soda, used to permit slowly perishable foods to be used over considerable periods of time from open containers, are not injurious in any proper concentration; overdosage of the food with the antiseptic, practised sometimes to check a decomposition which has already begun, is more likely to do harm.

Large Bowel.—The large bowel receives from the small bowel the food roughage, from which nutritious elements have been absorbed. Vegetable fiber, bacteria, and other matter which is not nourishing, is mixed with water to a thick liquid consistency. The large bowel functions by taking out much of the water and leaving the food waste more solid. The absorption of the water is attained by continued passage and repassage of the material over the membrane. In the first part of the large bowel peristalsis in the reverse direction (anti-peristalsis) keeps sweeping back toward the closed upper end, and water is gradually taken out and into the blood stream. When sufficiently dried of excessive moisture, a downward peristalsis carries the material along. The downward propulsion in the lower bowel is stimulated
by the mechanical pressure of this material and by the chemical action of some constituents.

**Constipation.**—A moderate amount of semi-solid material is normally carried; an increase in this amount stimulates the nerve ends, and through them peristalsis. If the food eaten is chiefly nourishing and has little bulk, that which reaches the lower bowel is insufficient to stimulate movement. This results in constipation, the most frequent disorder of the tract. A tendency to constipation seems sometimes to be inherited, together perhaps with a sagging of the viscera, and sometimes to result from such uncontrollable disorders as chronic appendicitis. More common factors are within our control; among these are improper diet, worry, irregularity of habit and chemical catharsis.

**Catharsis.**—Futile attempt is often made to remedy an inactivity of the bowel by the use of cathartics. We will here employ the term cathartic in a limited sense, to include all the classes of active drugs which cause bowel movement. Castor oil, cathartic salts, and cathartic pills have a very wide sale as remedies for constipation. Their action is by an excessive stimulation which tends to empty the lower bowel. This tires out the nerve-muscle mechanism and for a period removes all the pressure stimulus of the contents. Consequently, the action is afterward more sluggish and the constipation more pronounced than at the start.

A tendency to constipation becomes progressively worse under treatment by cathartics. The normal bowel will stand a certain amount of catharsis without injury, but the constipated bowel is one with an already weakened functioning power and the cathartic further impairs it. Large water or soapsuds enemas empty the lower bowel just as cathartics do, and are followed by corresponding periods of constipation. The habitual so-called "internal bath" is anything but a hygienic device.

**Diet for Constipation.**—The logical management for constipation would be of just the opposite type. The bowel's operation should be helped into its natural state. An increase of bulk foods brings back the normal stimulation by pressure. The coarse foods, such as potatoes, greens, and other vege-
Tables which are rich in fiber, are to be substituted for such highly nutritious foods as eggs, sweet milk, and meats. The objection to this latter group of foods is that they take away the appetite for coarser ones. Bread and butter in large quantity provides bulk and is desirable. White bread has considerable bulk, rye bread more, graham bread still more, and bread containing bran the most of all; their anti-constipation value ranks accordingly. The only chemical stimulants to be desired are those in ordinary foods, such as buttermilk and cooked or raw fruits; the acids of these foods are laxative, but too mildly so to do harm.

Other Measures.—Except in babies, the pressure by abdominal muscles plays a major part in the movement of the bowel. General physical exercise, or special exercise or massage of the abdominal muscles, counteracts a sluggishness of the bowel. Exercise also serves as a relief from worry, and improves the appetite for coarse foods. In all these directions it combats the tendency to constipation. Evacuation of the bowel at a regular time each day is another aid. Forced drinking of water adds moisture to the body fluids, and prevents their taking out so much water from the contents of the large bowel; this counteracts constipation.

If temporary relief must be sought, a simple oiling of the large bowel is the least objectionable means; this lubricates and to some extent checks the drying out of the bowel contents. Olive oil or some cheaper vegetable oil may be used as a retention enema, a few ounces being retained overnight. If taken by mouth the vegetable or animal oils would for the most part be absorbed as nourishing food before reaching the large bowel. Mineral oil (liquid petrolatum: paraffin oil), on the other hand, is not absorbed to the system and passes unchanged into the large bowel; it tends to relieve constipation when taken by mouth. Several ounces daily may be required for any effect. Glycerin suppositories irritate only the lowest stretch of bowel and are less objectionable than the cathartics, which would irritate a larger part of it.

Infants' Constipation.—For babies, about a teaspoonful of malt soup extract mixed into the daily feeding is usually sufficient to combat any tendency to constipation. Inactivity
of the bowel for more than a day with babies calls for relieving measures, though active chemical catharsis is quite as bad or worse for infants and children than for older people. Use of the infant's size glycerin suppository is as practicable and much less injurious. If suppositories are given repeatedly, this should be at a regular time each day in order to help reëstablish a regularity of movement.

**Diarrhea.**—Diarrhea is frequently a symptom of some general disease, and unless it tends shortly to subside should have the underlying cause determined by a physician. The diarrheal condition means that the bowel is being over-excited, and for recovery it needs a rest from this excessive stimulation. Avoidance of bulk foods eliminates much of the stimulus to excessive action. Any of those foods which excite peristalsis retard recovery, and are to be discontinued until the condition is corrected.

During the very acute stage the best diet contains nothing more irritating than a strained gruel, taken in small amounts every hour rather than in larger amounts at meal-time. As the condition begins to improve, boiled milk is gradually substituted for the gruel. As the diarrhea stops other foods are added. In addition to the changes in diet, it is important that the patient remain in bed and during a major part of the time keep a hot-water bag to the abdomen.

**Infants' Diarrhea.**—Diarrhea in babies is managed along similar lines. The regular feedings are discontinued for a while, and instead of them only water or barley water is given. As the condition improves, the feedings go back to a weak dilution of milk, at first boiled. Sugars are withheld until the diarrhea entirely stops; saccharin—one grain to the quart—may be employed as sweetening if the baby refuses fluids otherwise. The largest possible quantity of water is to be given the baby with diarrhea, for the gravest danger is created by a drying out of the tissues due to loss of the fluid discharged. It is never safe to take chances with an infant's diarrhea, and anything worse than the mildest and most fleeting of attacks should be referred to a physician. Preventives of diarrhea in infants, particularly of the serious summer diarrhea, are discussed in a later chapter.
Reading.*

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CHAPTER VII.

RESPIRATION AND BODY HEAT.

The Lungs.—The mucous membrane in the lungs passes oxygen into the system, and passes from the system such body waste as assumes gaseous form. It forms into sacs, in which the air is being constantly renewed and freshened so as to maintain a high concentration of oxygen; some of the oxygen passes on through to the bloodvessels beneath.

The air sacs open into the smallest of the windpipes (bronchioles) and these converge into larger ones (bronchi); the latter open to the exterior through the crooked passage to nose and mouth. As the chest cavity expands in breathing, it sucks in outside air, and as it reduces it forces out some of the air contained. The system of branching windpipes and air sacs is the lower respiratory tract, and the crooked passage to the exterior is the upper respiratory tract.

Absorption of Gases.—Gases other than oxygen likewise pass through the membrane. Some of the anesthetics, as well as certain other medicines, are introduced to the tissues through this route. An instance is the volatile amyl nitrite, which is breathed in to quiet the spasms of angina pectoris. Poisonous gases enter similarly, and unfortunately the most poisonous are not those which would be avoided because of a bad odor. Odorous gases of decomposition are not injurious, whereas some gases with a pleasant odor are very much so.

Poisoning occurs from zinc fumes among brass workers, from benzol fumes among workers with dyes and some rubber preparations, and more acutely and seriously from carbon monoxide under many conditions. It is prevented only by avoidance of the fumes. Coal gas, or other mixture containing carbon monoxide, so changes the hemoglobin in the red blood cells that these cannot carry oxygen to the tissues.
Carbon monoxide has no warning odor, though fortunately the mixed gas which contains it often does. The smell of illuminating gas warns people away; so does that of sewer gas, which at times becomes injurious from a leakage of gas into it. A person who has been overcome by a gas should be carried or dragged to a place with good air supply, and given artificial respiration.

**Artificial Respiration.**—Artificial respiration is the principal first-aid measure for those who have stopped breathing because of electrical shock or drowning, as well as for those poisoned by a gas. Aeration of the lung membrane can be brought about by any of several methods of manipulation. A good one for general use is that of Schaefer.

The patient is laid face down on the ground or floor, his arms extended above the head, and one elbow crooked to support the head. The manipulator straddles the patient over the thighs and pushes in hard on the lowermost ribs, resting his weight on them; releasing the hold, he allows the chest by its elasticity to expand and suck in a little air. The pressure and release is repeated about twelve times a minute until the patient himself breathes. This method works not only the muscles of the chest wall but also the main breathing muscle or *diaphragm*, a muscular sheet separating chest from abdominal cavities.

**Normal Breathing.**—The relaxed diaphragm during expiration is drawn upward, and during inspiration its flattening contraction enlarges the cavity of the chest. Shallow breathing may be almost entirely by this muscle; deep breathing calls on the muscles of the chest wall as well. A mere forcing of the action of these muscles can be but a brief breathing exercise by one at rest, for the excessive oxygen absorbed excites to faintness or dizziness. Strenuous muscular work is better as a deep breathing exercise, for tissues at work utilize more oxygen and to supply them a breathing center in the brain deepens the respiration.

Habitual shallow breathing does not greatly affect the lungs. It allows the membrane of the upper portion of each lung to collapse, and in this collapsed condition the lung tissue is sometimes thought to be attacked more easily by
tuberculosis. This condition is not, however, a major factor in the causation of tuberculosis; athletes who breathe deeply are not infrequently among those attacked by this disease. Deep breathing fills the entire lungs with air, to which it opens up all of the many yards of membrane, and this might possibly add to the resistance of the lungs. Deep breathing should be encouraged even if it did not affect the respiratory system at all, for it benefits posture and other functions of the body.

Hiccough.—Hiccoughs are spasms in the diaphragmatic muscle. They are sometimes caused by inflammatory disease about the muscle or about its nerve supply, and sometimes much more harmlessly by temporary conditions in the stomach or even as a habit spasm without assignable cause. The relief occasionally to be obtained from a large drink of water, or that from a forced discontinuance of breathing motions for a time, is familiar to all. Hiccoughs which persist obstinately for days suggest the more serious causes. Inflammation which spreads extensively about the abdominal cavity (general peritonitis), and that which involves the brain (encephalitis), are among the diseases likely to have this as a symptom. Ordinary hiccoughs in the baby result from the overfilling of the stomach with food and air, and stop when part of the material passes on into the bowel.

Upper Air Passages.—The upper respiratory tract includes the nose, sinuses, throat, mouth and larynx. The passageway through these organs admits air to the lungs and cleans and warms it in passage. It is lined throughout with mucous membrane, which is kept warm by a rich blood supply and kept wet and sticky by mucus from its glands. Wet and crooked tubes all tend, by catching dust on their walls, to clean and sterilize air passing through.

Obstruction to Breathing.—A septum separates the left from the right nasal cavity, and shelf-like protuberances (turbinates) extend into the respective cavities from their outer walls. These structures increase the extent of membranous surface over which the air current must pass. If normal, they facilitate the warming and cleaning of the current, but if deformed from faulty development or accident,
they impede this current in passing to the lungs. The septum may be bent (deflected) or the turbinates enlarged, and these defects close either partially or wholly the nasal cavity. Another common site for obstruction is just behind the nose. Growths of lymphatic tissue (adenoids) often develop in the top of the pharynx and close the opening from the nose. In children, the tonsils sometimes enlarge into a partial obstruction.

Fig. 15.—Upper air passageway.

Obstruction in the nasal passageway forces more of the current to the mouth; breathing may be through the mouth entirely. This involves a poorer cleansing and warming of the inhaled air, and it interferes with the quality of the voice. Dryness about the mouth and throat may result, causing at the time a bad taste and more remotely a catarrhal inflammation. A consequent interference with hearing may ensue. Constant and continued mouth-breathing by children alters the bony growth and deforms their faces. Partial obstruction tends to broaden the bridge of the nose and complete obstruction to narrow it. The expression becomes stupid, and in some cases an actual depression of mentality results. Permanent obstructions should by all means be removed surgically.
Smoke and Dust.—Smoke and dust reach the lungs with inspired air, due to imperfect cleansing of the current in the upper passages. Mouth breathing makes matters worse, though in no one can the smoke and dust of a dirty city be kept from the lungs. The lung tissue of city dwellers is blackened by the smoky air until a gray mottling replaces the uniform pink which characterizes the lungs of country people. Fortunately, the mottled lungs function just as well as the pink, and seem no more prone to disease. The smoke is a nuisance because it soils so many other things besides the lungs, and because it shuts off part of the sunlight.

Many of the dusts on inhalation prove to be less harmless than smoke. Dusts hard and sharp enough to scratch the membrane of the lung favor the development of tuberculosis. Men who work in the dusts of stone, metals, and ore have a much higher tuberculosis-rate than those working in the softer dusts of coal, wood, starch and soil. Granite cutters have a high rate. Coal miners in properly ventilated mines do not, though there is a predisposition to milder respiratory disorders.

Inhaling of Bacteria.—A second factor in the causation of respiratory disorder by dusty air is the bacterial contamination of the dust particles. This has been suggested as a reason why persons engaged in dusty indoor occupations have a relatively high rate of respiratory disease. The membrane offers little resistance to the many infective agents that enter with the dust or spray in the air. That of both the upper and lower tract is susceptible to much infection, and it permits other infection to pass through without itself being inflamed.

Infections of the lungs themselves do their greatest damage to functions other than respiration. The respiratory membrane is so extensive that a large part may be thrown out of function without any great effect on the supply of oxygen to the blood.

Pneumonia.—The circulation is the function most seriously endangered by an attack of lobar pneumonia. Great portions of the lung tissue are solidified by the inflammation and this impedes the freedom of the blood's flow; there also are other factors of strain on the heart. The resistance to
pneumonia is lowered by alcoholism, age, chilling, or other infections, and any control of these influences reduces the risk of death from pneumonia. Some degree of specific immunity can be acquired through anti-pneumonic vaccination, and this also would reduce the hazard somewhat. The germ of pneumonia, or pneumococcus, has already been alluded to, as has also the distinction between lobar pneumonia and bronchopneumonia.

**Tuberculosis.**—Tuberculosis is the commonest of respiratory infections. The germ, *tubercle bacillus*, attacks and produces demonstrable small lesions about the lungs of practically all civilized people. Those whose resistance to the germs falls very low develop consumption. Loss of weight, afternoon feverishness, sweating at night, obstinate though perhaps mild cough, or the coughing up of blood suggests that one's resistance may be giving way. None of the symptoms have this significance necessarily, but if they persist it is a possibility which should be looked into.

Treatment or prevention is by nursing up general resistance to limit the lesions. Good nourishment, open-air life, regular habits and the avoidance of worry and fatigue are the main items. Public measures aim to reduce the extent of the general exposure to tubercle bacilli, as well as to build resistance in individuals. The authorities try to keep active cases away from children, whose resistance is likely not to be high, and to have the cases whose expectoration is most infective go to sanitaria. Free dispensaries refer cases to the sanitaria and teach people how to build up their resistance and protect others by guarding the expectoration. The greatest activity is needed in congested districts, where the prevalence of tuberculosis is highest; the rate in down-town lodging-house and factory wards is perhaps twice a city's average, and that in the better residence wards, half.

**Respiration.**—Functionally, the respiratory system is concerned with the provision of energy for life processes. The supply of energy comes primarily from the sun, in its rays. The green matter (*chlorophyl*) in plants absorbs some of the rays and builds them into the plant's constituent carbohydrates. Animal tissues acquire their warmth and other
energy by burning the carbohydrates and getting out the energy stored in them. As the enveloping air greatly retards the passage of heat, their warmth does not immediately leave them.

The air has two properties which are essential to life. It holds in the heat, which is necessary for the functioning of tissue and which without the surrounding air would at once leave the body. It also supplies oxygen for the burning of food in the tissues; burning is the combination of a material with oxygen. This process is known generally as combustion; in the body it is known also as internal respiration. The designation as internal is to differentiate it from the breathing function, which is called external respiration.

The red blood corpuscles form a means of feeding oxygen to the tissues, their red matter (hemoglobin) being capable of holding oxygen in loose chemical combination and later of giving it up. Oxygen is so concentrated in the network of bloodvessels beneath the mucous membrane of the lung that it forces itself into the red matter of these cells as they pass. It later diffuses from the red cells into the fixed tissues, being drawn by the much lower concentration there. Tissue cells retain the oxygen, together with sugars and other fuel food, until a combination of the mixture is needed for production of energy.

Vital Energy. — When any fuel unites with oxygen, heat and power are evolved. Tissues get their power from the burning of fuel foods, just as motor cars do from the burning of fuel gas. The latter mixes with oxygen in the carburetor, and the mixture goes into the cylinders where it is lighted by an electric spark and combines, to give power to the car. Combustible foods which have entered the body through the digestive membrane mix in the tissues with the oxygen brought by the red cells. When contraction of muscle is called for, a nervous impulse sets off their combustion. Outside the body a much higher temperature would be required for such combustion as takes place in the tissues, and how this can occur at the lower temperature is not clearly understood. Intricate chemical reactions are involved. The final result is the same as if the process had been along better
understood lines; energy is liberated and the same material end-products as of an ordinary combustion.

**Carbon Dioxide.**—Chief among the end-products is carbon dioxide. This is thrown off by the tissue in quantities proportional to the work done, and mixes into the fluids throughout the body. Though a waste product, it serves a useful purpose before its elimination; its presence in the blood controls breathing. When the content of carbon dioxide reaches a certain point one cannot hold himself from taking a breath, for at this concentration it stimulates a center in the brain to cause inspiration. Excess over this concentration passes from the blood to air sacs of the lungs and is breathed out.

**Animal Body Heat.**—The degree of body heat required for animal functioning varies within narrow limits. Though a great surplus of heat is taken in, the body function of heat regulation discards accurately the excess. The regulation is controlled from another center in the brain, which corresponds in function to the breathing center just mentioned. When the body temperature falls too low or rises too high, this center provides for an accumulation or elimination of heat. The temperature remains normally at about 100°F, a few degrees higher in some of the deep tissues and lower out toward the surface. The skin is about 98°F. where protected from external cooling, and where not so protected has a variable temperature, sometimes as low as freezing. The mouth temperature is about that of the protected skin, and the rectal temperature a degree or so higher; there is a normal variation of some two degrees among individuals. In infants, the temperature is a degree lower than in older persons.

**Fever.**—Fever indicates such derangement of the brain’s heat center that it regulates high. The management of fever is directed less at the heat producing tissues than at the regulating mechanism. The strain is taken off the latter by rest in bed, which also quiets the unnaturally active tissue changes; this is the most essential part of the management. If heat production needed to be cut down, the fuel foods would be reduced, but this is not the case. The regu-
lator determines how much heat is to be acquired by burning, and if the burning is not of fuel foods it must be of tissue substance. The modern diet for fever is not starvation, but as full feeding as the weakened digestive tract can stand.

An active abstraction of the fever's heat is sometimes employed, though only for temporary relief. Chilling the skin by a cold sponge or bath causes the heat to drop several degrees within a half-hour, but during the next half-hour the body heat comes back gradually to the point of nervous regulation.

Control of Body Heat.—The governing center throws off the excess of heat from the skin. When the tissues become overheated, a greater part of the warm blood is brought into the cooled surface of the body; the skin flushes. The regulator in the brain needs a well cooled skin for its greatest efficiency; with this it can cool the blood as much as is required and to prevent overcooling can withdraw it again from the surface.

Heat from the skin radiates to the cooler surroundings, and to a less extent is swept away by currents of air or absorbed by the evaporation of moisture. Vaporization of the sweat absorbs heat, in part that of the body. Loss of heat can therefore be promoted by three measures. The skin should have access to cool air or other surrounding medium, into which heat may radiate or be conducted. It should be swept by air currents, which promote evaporation of sweat and blow away the warm, sweat-moistened film next the skin. The air should be dry enough to vaporize the sweat rapidly. Cooling of the skin is not to be so extreme as to exceed the mechanism's range of efficiency. The body cannot hold its required amount of heat against too great odds.

The center accumulates what additional heat is needed through impulses that add to the burning of fuel by muscles. Shivering indicates that combustion is being speeded up for this purpose. In lower animals the mechanism also conserves its supply of heat in cold weather by the ruffling up of the hairy coats, to hold more still air. The analogous goose-flesh reaction in human skin is ineffective because the hairs
are too small. To compensate, man must use more intelligence; clothing is worn and houses are heated.

Physical comfort supplies the only practicable index of a desirable amount of exposure. Clothing and the heating of the house should be made to afford the least quantity of warmth that permits comfort. Cooling to the point of discomfort does not promote health, though by gradually adding to the severity of exposure colder surroundings are made comfortable and hygienic. Delicate children in quite wintry open-air schools are comfortable and improve by the exposure, though they may be cold to the touch of someone coming from indoors.

Clothing.—Warmth of clothing, like that of the furs or feathers of lower animals, is afforded principally by the air between its fibers. This retards the passage of heat, just as does an enclosed air space in lightly built walls. Warmth in cloth depends more on the air held than on the fabric's weight and substance. Loose meshed cloth holds more than that which is woven closely, and makes a warmer garment. Cool cloths are those without much air space in the meshes.

Cotton is cooler than wool. As its fiber is flat and limp, the air is pressed from its meshes much more readily than

Fig. 16.—Fibers of (a) cotton; b, wool.
from about the elastic fibers of wool or silk. The two cloths of animal origin have stiff and elastic fibers; the wool fiber is coarsely cylindrical and has a scaly surface, and the silk is more finely cylindrical and smooth. The cotton blanket is woven to contain a good deal of air and is at first warm, but it loses much of its warmth on laundering because the air is pressed out. This is not so much the case with a woolen blanket, due to the stiffer fiber. For warmth, one selects a loose meshed woolen cloth. Silk can be made warm, but it usually has such close weave as to exclude too much of the air.

Color of Clothing.—The color of clothing is a factor in hot weather. Dark colors absorb and radiate heat, and tend to pass to the body any excessive heat of the surroundings. Except on hot days, the color does not materially affect the warmth of a fabric. It is only in the outer garment, which is exposed to the light, that color has any influence on warmth. The reputation of red flannels for special warmth is unjustified and is said to date from a time when the red dyes obtainable assumed different shades of color in wool and in cotton; as such dye would have betrayed the presence of any cotton it was not used for impure woolens.

The dark color of cloths used for winter clothing has less to do with warmth than with an unsoiled appearance. The keeping of white clothes attractive is something of a bother. Under ordinary conditions there is little hygienic argument for keeping every vestige of dirt out of clothing. The better record of white for cleanliness leads to its popularity for the uniforms of hospital internes and nurses.

Underclothing.—Warmth is not such an essential quality for underclothes, except in very cold climates. It is better to depend on extra garments when out of doors and to avoid too much clothing in the house. The element of selection for underclothing materials has more to do with the absorption of moisture from the body, and its ready evaporation. As moisture is first absorbed into the air spaces between the fibers, the loosely woven cloth absorbs it the best. The nature of the fiber affects the retention of moisture in the cloth. Wool fibers, being markedly hygroscopic, take up moisture from the air spaces and hold it. Cotton and linen
cloths, having the less absorbent vegetable fibers, allow readier evaporation of the moisture in them. If loosely woven they both absorb rapidly and dry out rapidly, and are the more efficient for the removal of perspiration from the body.

Persons who sweat but mildly find cotton preferable as a rule, in an average climate of the temperate zone. Some are safer and more comfortable in woolens, particularly rheumatic persons and others who at times sweat profusely and are liable to injury from chilling. When cotton and linen become saturated, the moisture drips out and the garment clings to the skin. It then feels clammy and chills, for water conducts heat rapidly. Wool would retain the same amount of moisture, due to its less collapsible mesh and its absorbent fiber, and leave air space next the skin; it would not feel so wet.

Shoes which retain moisture about the feet, in conjunction with cotton stockings, chill the feet of some people. Physicians not infrequently advise the wearing of woolen stockings during convalescence. Footwear should be such as to permit the feet to dry. Sandals do this best, but fabric and leather shoes are also good. These absorb moisture and give it out to the air currents. The dressing process of patent leather curtails this capacity, and patent leather shoes or rubber overshoes are in this respect objectionable.

**Ventilation.**—Ventilation of the house might at first glance appear to influence chiefly the breathing requirements, but it has a much greater influence on the body’s regulation of its heat. The air’s content of oxygen and carbon dioxide is modified but slightly by poor ventilation. The air has about 20 to 21 per cent of oxygen, and several per cent less is ample for respiration; slight quickening and deepening of the breathing easily compensates. Crowding in a badly ventilated room does not reduce the oxygen nearly this much.

Moderate excess of carbon dioxide in the air is also harmless; the content could not rise to more than a small fraction of 1 per cent, and in certain industrial work a content higher than 1 per cent proves to be associated with no discomfort or ill health to anyone. Carbon dioxide and an undefined
"crowd toxin" have at different times been thought harmful, but neither these nor other exhalations from a normal body would in any ordinary concentration be poisonous. Neglect of the ventilation of a room affects the quality of the air for breathing purposes only if illuminating gas or other poisonous fumes have leaked in.

On the other hand, ventilation influences greatly the regulation of body heat. The air of the house should be cool enough to promote a radiation of heat from the body. It should be sufficiently dry to vaporize sweat, though not so excessively dry as to parch the skin and membranes. It should be stirred into such currents as will sweep away the warm film of water vapor which collects about the body. A badly ventilated room lacks air currents, and when crowded it assumes excessive warmth and moisture; all means for the loss of heat are then interfered with, and discomfort results. By ventilation is meant a provision of good air, and good air promotes heat abstraction. Other qualities of the air, as affected by ventilation, will be considered in other connections.

**Temperature.**—In winter, the desirable temperature for sitting rooms is around 68° F. Most American people have accustomed themselves to a temperature of 70° F. to 75° F., which is too high for the best functioning in the average person. Other rooms need not be kept so warm, and the bedrooms are better kept quite cool. Most persons do not have the resistance to rest comfortably in a bedroom with a temperature below freezing, but anything above freezing is usually tolerated by those used to it. Heating of houses will be considered more fully in connection with domestic hygiene. In summer, when the temperature rises until beyond control, the hygienic cooling of the body depends more on air currents.

**Circulation of Air.**—In warm weather, the problem becomes almost entirely one of stirring up a breeze, by the open window or the electric fan. In cool weather the air currents play a smaller though still important rôle. They are produced if the heating units are installed near the floor, as the heated air rises and stirs up circulation. Introduction of outside
cool air should be deflected upward, to create currents as it settles down. The exchange of the room's air content for outside air not only creates currents but also rids the house of fumes, odors, and perhaps dust or an excess of moisture.

**Humidity.**—A very dry air leads to chapping of the skin and other discomforts; an excessive moisture on warm days retards the evaporation of sweat, and on cold days chills. A desirable humidity for the air is about 50 per cent of its capacity moisture, spoken of as *relative humidity 50*. Relative humidity 100 would indicate the greatest amount of moisture which can be held in vapor form at that temperature. When a fully saturated warm air is cooled, there is an excess of water vapor beyond this new capacity which condenses, because cold air can hold less of the vapor than warm air.

When cold winter air is heated, its capacity for moisture rises and additional water is required to approximate the desired relative humidity of 50. Evaporation of water from cans about the radiator or stove helps to make up the deficiency, though this does not nearly meet the full requirement. Rarely is there any means available for overcoming the dryness of the air in winter.

By reference to standard tables, the relative humidity of a room is easily computed from the difference in reading between wet and dry bulb thermometers, swung about in an instrument made for the purpose. The evaporation of moisture about the one bulb cools it, the degree of evaporation and consequent cooling depending on the extent of the air's dryness.

**Artificial Ventilation.**—Devices for artificial ventilation are often necessary in theaters and other buildings where natural ventilation is inadequate due to the number of people who congregate in a limited space. As a rule these devices consist of mechanical fans. One method is to suck the air from the room (*exhaust method*), another to pump air into the room (*plenum method*), and a third to use fans acting in both capacities (*combined method*). In some ventilating systems the humidity is controlled, as well as the circulation and change of air; the current is passed through a chamber
moistened by a spray of water or otherwise. While artificial ventilation is frequently preferable for large buildings, natural ventilation is better suited to the home.

Catching Cold.—It is difficult to say just what harm is done by overexposure to cold. Tradition, possibly with some justification, has associated affections of various parts of the body with such exposure. "Colds in the head," "colds in the muscles," and "colds in the joints" have been spoken of widely, the first so much so as to give it a clear title by usage to the term *common cold*.

The common cold is an affliction of the upper respiratory tract, of which the cause remains obscure. A parasite of some sort plays a part, and the means of prevention is essentially the same as of other contagious diseases. The resistance to the parasite is probably associated, to some extent, with the heat regulating mechanism. A body whose heat function is made resistant by regular exposure to weather or cold baths is said to resist also the common cold. "Catching cold" would indicate that an unaccustomed chilling so strains this dual resistance as to permit colds to develop. The widespread assumption that a pleasant draught in warm weather exposes to colds, even though it does not chill, is certainly a mistaken one.

The best management for a case of common cold is the avoidance of chilling and rest in bed. Home remedies for colds, which consist usually in proprietary nose sprays or pills, relieve the symptoms in some cases and make the colds more bearable. It is questionable whether they shorten the course at all.

Heat Function in Childhood.—The heat function in childhood, and especially in infancy, is much less stable than in later years. Ailments which would cause little fever in an adult may cause a high one in the baby or child; the amount of fever in children is often no index of the malady's severity. The heat regulating center is in them quite easily deranged.

The center also has a comparatively narrow range of efficiency. Extremes of temperature are not effectively resisted for the first few years, and exposure to pronounced heat or cold is unsafe. Delicate babies are sometimes given oil rubs
instead of baths, because of the tendency of the bath to chill. When the bath is used, it should approximate the temperature of the body.

**Overwrapping.**—The care taken of the baby’s delicate heat regulating mechanism has often been scrupulously illogical. It has not been realized that excesses of heat must be eliminated, and that for this the mechanism needs a cooled skin. Bundling up of the baby is of value only when it protects from the cold. Such wraps as to make it perspire and fuss about in discomfort have nothing to commend them. Some people clothe the baby more warmly than they themselves could comfortably endure, and they argue the necessity of this for health maintenance. Too much clothing, as well as hot weather, causes prickly heat; the other effects may be worse. The severe and frequently fatal summer diarrhea in babies is attributable largely to an inability to eliminate excessive body heat.

**Summer Complaint.**—The occurrence of summer diarrhea (*summer complaint: cholera infantum: alimentary intoxication*) is in the period of very hot weather; there is a close relationship between the heat curve of the summer and the incidence curve of this complaint. It would appear that the heat itself is a causative factor. No opportunity for cooling babies during such weather is to be overlooked; they do not need clothing and they do need air currents. A gentle breeze from the electric fan is preferable to no breeze. The “colds from draughts” bugbear is largely responsible for the overwrapping and underventilation from which so many babies have been made to suffer. Other causative factors of summer diarrhea are the use of poor grades of unpasteurized milk and of badly proportioned feedings; they combine with the heat to cause the affliction.

**Reading.**

*General, Fisher and Fisk, Chapter I.*

*Mechanisms for Breathing and Heat Regulation, Hough and Sedgwick, Chapters X and XII.*

*See bibliography for titles and publishers of books,*
Respiration of Tissue, Mathews, Chapter XX.
Food Fuel, Oxygen and Carbon Dioxide, Harvey Lectures 1916–17, Lecture by J. S. Haldane.
Disorders of the Respiratory Passage, Cornell, Section on Nose and Throat.
Artificial Respiration, Lynch, Chapter VII.
Heat Regulation, Woodman and Norton, Chapter II.
The Tuberculosis Problem, Hill, Chapter XIV.
Foods.—A knowledge of the materials from which the body is built, and of the origin of the power it uses, must underlie any broad comprehension of nutritional hygiene. Body tissues are constructed from products of certain foods, and the power available to them is derived from the burning of these and other foods.

The foods of man must include protein, carbohydrate, fat, and such accessory substances as vitamins, etc. Foods from which tissue is built are for the most part protein. Protein is the conspicuous ingredient of lean meat, eggs and fish. It differs from other types of food in containing nitrogen, and occasional other elements, in addition to the hydrogen, oxygen, and carbon, common to all. Sugars and starches after digestion are readily burned to supply heat and power to the body; these are among the carbohydrate substances in which organic nature abounds. Fat foods also supply fuel; they burn less readily than the carbohydrates but when burned give off more heat and power.

Tissue Building.—Of primary concern is the formation of tissue from protein foods. Let us say that beef muscle, as meat, is to be converted into living human muscle. In order to pass through the intestinal wall and into the tissues, the meat must be dissolved and broken down; only the comparatively simple derivatives of protein called amino-acids are assimilable. Crude proteins are extremely complicated in chemical structure, combining in themselves over a dozen different kinds of amino-acids; this union must first be broken by digestion.

The processes necessary for breaking down these complex substances into assimilable form are such involved ones that
it is well nigh impossible to pass proteins to the tissues through channels other than the digestive tract. Direct introduction to the blood stream of a simple sugar supplies the tissues with fuel, but it is not possible in this way to furnish them an appreciable quantity of protein. Nutrient enemas of eggs and milk have been given to patients whose stomachs were thrown out of function by disease, though little is accomplished by this as the substances do not reach such parts of the tract as would digest and absorb them.

**Digestion of Protein.**—Coagulation of protein is a preliminary to its digestion. Cooking coagulates the albumens of meat just as it does egg white. Uncooked albumens are coagulated by the juice of the stomach, due principally to the hydrochloric acid there. Animals with a very strong stomach acidity, the dog for instance, do not show preference for cooked food. The subsequent digestive action is by several sorts of ferments, which are variously aided by the acid of the stomach and other materials. The complex protein must go through three distinct stages of dissolution in order to reach the form of amino-acids, and each stage requires a different ferment.

The occurrence of the proteolytic ferments is largely in the following digestive juices:

Proteins are broken down

<table>
<thead>
<tr>
<th>Stages</th>
<th>Ferments</th>
</tr>
</thead>
<tbody>
<tr>
<td>to peptones and proteoses</td>
<td>by <strong>pepsin</strong> and <strong>rennin</strong></td>
</tr>
<tr>
<td>then to intermediate products</td>
<td>by <strong>trypsin</strong></td>
</tr>
<tr>
<td>then to amino-acids</td>
<td>by <strong>erepsin</strong></td>
</tr>
</tbody>
</table>

**Assimilation.**—The amino-acids pass through the wall of the small intestine to the blood stream, which distributes them to the body cells. After entering the cell, they unite again into a complex protein substance, similar perhaps to the muscle tissue which was eaten to supply them. The amino-acids derived from eggs, cheese, beans and other foods
can be rearranged by the body into the form of muscle, if all the kinds of amino-acid which constitute muscle are present. Gelatin is a protein which lacks some of the amino-acids which the tissues must have, and only in combination with other proteins would it be a tissue building food.

**Metabolism.**—New protoplasm is continuously building up in the tissue, and the old breaking down. These changes are spoken of as tissue metabolism. There are factors other than the supply of foods which influence the building of tissue. The condition of malnutrition can be due not only to a lack of food products, but also to an impediment which hinders proper assimilation of the food products present. Systemic disease causes a malnutrition much greater than the reduction in food intake could account for. Conditions which disturb the metabolism of the body are of great diversity.

One of the normal influences on metabolism is the reproductive tendency inherent in tissue. Another is the action of internal secretions. Another is the action of certain rays of light. Some rays beyond the violet end of the spectrum penetrate in varying degree all the tissues of the body, though they do not pass as do visual rays through ordinary glass; the roentgen-ray is used to find fragments of glass in the body. Roentgen-rays and similar rays from radium react on the tissues entered and prove medically to aid tissue growth. The effect is so powerful as to require careful dosage; overdosage of roentgen-ray has led to cancer and other disorder of the tissues.

An excess even of sunlight is injurious in some forms of tuberculosis, in which proper doses would be helpful. Metabolism of normal or diseased tissue is influenced to a definite degree by the ultra-violet rays in sunlight, unfiltered by glass. These rays are much nearer the visual spectrum than are those above mentioned, and have less penetrative power, but either directly or indirectly through their effect on the skin they do affect the deep tissues. Furthermore, they are necessary to the healthy metabolism of such tissues. This applies particularly during the vigorous growth of childhood. Lack of sunlight in babies appears to be a principal causative
factor of rickets. Since the rays of the sun which react best on tissue growth lie close to those which act on camera films, the stimulating effect of a light may be estimated as roughly proportional to its suitability for amateur photography.

**Urticaria.**—One disturbance of metabolism consists in a peculiar reaction of the tissue to poorly assimilable tissue foods. Many individuals have this peculiar intolerance for some certain protein food, even when eaten in very small amounts. A disagreeable condition called hives, or *urticaria*, results, in which the skin breaks out with an intensely itching rash. Hives has resulted from the eating by susceptible persons of different varieties of shellfish, meats, milk, eggs, grains, berries or melons. The trouble is with the individual rather than the food, for all these foods are wholesome for the average person. Various mineral salts and other substances cause in those sensitive to them a rash corresponding in many ways to the protein rash of hives. The management is simply the avoidance of any poorly tolerated articles; medical assistance is often required to find which is the troublesome food.

**Tissue Waste.**—Waste products thrown off in the course of the metabolic changes of tissue pass into the blood stream and are converted largely to urea by the liver. The kidneys excrete urea, as well as uric acid and other waste, to the urine. The painful joint symptoms in gout are due to an accumulation of protein waste, the proper elimination of which is prevented by the disease. Articular rheumatism and various other ailments have been erroneously associated with uric acid accumulation. Patent medicine advertisers capitalize popular misconceptions of this sort.

Waste products find their way to some extent also into most body secretions and excretions other than the urine, though the amount so disposed of is too small to lessen appreciably the load on the kidneys. In cases of very pronounced disease of the kidneys, physicians attempt to produce additional elimination through the sweat glands and bowel. Waste in gaseous form, less from the changes of tissue growth than from the burning of fuel, is eliminated principally from the lungs.
Fuel Food.—The nutritional function, in addition to the building of tissues, provides them with fuel to be burned for power. Power is generated in the body cells when the fuel foods unite with oxygen. This is energy metabolism, or the internal respiration previously referred to. The blood stream distributes fuel food to the tissue cells, just as it does the amino-acids. There is some burning of protein for the generation of energy, though other foods serve this purpose more conspicuously.

The carbohydrates available for tissue fuel are those which can be absorbed into the system, namely the simple sugars and other carbohydrates which are convertible into simple sugars by digestive juices. Wood is a carbohydrate which produces heat on union with oxygen, but it is not a food because human juices cannot digest it. The animal and vegetable fats can be broken down and absorbed, so they similarly are fuel foods. Mineral oils cannot be broken by the human digestive process and therefore are not foods, but pass through the bowel unchanged.

Carbohydrate.—Carbohydrate foods may be: (1) Simple sugars (monosaccharides) such as glucose and fruit sugar; (2) compound sugars (disaccharides) such as cane sugar, milk sugar and malt sugar, the molecules of which are combinations of two simple sugar molecules, or (3) higher carbohydrates (polysaccharides) which are still more complex and appear unlike sugar. The higher carbohydrates include starches, abundant in such articles of diet as bread and potatoes. They include also plant fiber or cellulose, abundant in greens and other coarse vegetable foods. Plant fiber cannot be broken down by human digestive juices, and when used as a food it constitutes the non-nutritious bulk, which is depended on to combat constipation.

Digestion of Fuel Food.—Starches can be broken down by a starch-splitting juice, chiefly of the pancreas, into compound sugars. Compound sugars are broken down by sugar-splitting juices of the small intestine into simple sugars. The simple sugars are absorbed as such by the membrane. The bile in the intestine emulsifies and otherwise changes fat to facilitate its digestion and absorption. Pancreatic ferments
digest the fats into fatty acids and glycerin, both of which are absorbed through the intestinal mucous membrane to the chyle vessels, where they reunite into fat and as fat are passed on to the blood.

Digestive activity which most largely prepares the fuel foods for absorption may be represented as follows:

Starches are broken

Fats are broken

to compound sugars then to simple sugars.
to glycerin and fatty acids

by amylase by lipase in pancreatic juice.

by sucrase, maltase, lactase, etc. in intestinal juice.

Glycogen.—The absorbed sugars are held in the liver, muscles, and other organs as glycogen, until needed by the tissues. Glycogen is a higher carbohydrate, built from simple sugar and convertible back into simple sugar when required for burning. Excessive sugar in the body fluids is itself in many ways toxic. The low sugar tolerance in diabetes results from an interference with the formation of glycogen. The unconverted sugar which accumulates leads to inflammation of various tissues and eventually to a comatose condition and death.

Recent discoveries have afforded a pancreatic preparation—see paragraphs on Internal Secretions—which, when injected into the body, causes a conversion of sugar into glycogen and makes good the defect due to the disease. Unless such a conversion can be effected, the patient with diabetes must reduce the sugars and starches of his diet to minimal amounts.

Storage of Fuel.—If a large excess of food is eaten, a portion goes through the bowel unabsorbed. The blood does, however, take in much more than the amount actually needed. Any surplus of sugar over that demanded for the activity of the tissue is changed into fat, and as such is stored in the fatty tissues. The surplus of fat taken in is
likewise stored there. When the supply of glycogen and sugar runs low, the fat is brought from storage to be burned by the muscles. When the fatty tissues are exhausted of their fat, the tissue protein itself is burned to produce energy. This brings the real period of starvation, when all the stored fuel is exhausted and the framework of the body is being broken up for fuel.

**Fuel Value.**—The desirable amount of fuel food in the diet is proportional to the amount of energy required. Mere living consumes a dozen units of energy per pound of weight daily, and mild muscular work half as much more. The energy unit is the amount of heat which raises 1 kilogram of water 1° C.; this is called a large calorie. Engines all consume an excess of fuel over the amount actually transformed into power, and usually we allow the body enough fuel to produce 20 calories of energy per pound weight daily. If the person does hard manual labor for a day, he expends correspondingly more energy than when at study, and the desired amount of food per pound weight would probably have at least a 25 calorie value. In childhood the requirement is higher.

In normal persons the appetite approximates the caloric measure just suggested, and is a sufficient guide to proper quantities of food. An appetizing diet which maintains weight without piling on fat, and which provides such evidences of health as a good color and freedom from unpleasant symptoms, is acceptable without caloric computation. It is easy and sometimes worth while to compute the fuel value of a diet. Proportioning from the weight, while less sound than from height and weight or extent of body surface, is sufficient for practical purposes.

**Caloric Feeding.**—The adult indoor worker is allowed each day sufficient food to produce a number of calories equal to twenty times the body's weight in pounds. For instance, a person weighing 150 pounds gets 3000 calories. Reference to a caloric food table shows how many calories of energy each kind of food produces, and by adding up enough portions to total in fuel value 3000 calories, we arrive at an average normal ration.

The proportion of this food which should be protein is
roughly constant, and amounts to about one-tenth. Tissues require fuel and they wear out in proportion as they are worked; this fraction of protein in the diet is needed to keep them in repair. The food which yields 3000 calories, therefore, should contain an amount of protein sufficient to yield 300 calories, or 2 protein calories per pound weight.

In arranging the day’s diet, articles are first listed according to taste and other considerations to be given presently. Breakfast, lunch, dinner, and anything to be eaten between meals, are included on the one menu card. Opposite each item is entered the caloric value of the portion desired, this being estimated from the caloric value per pound as given in a standard table. Many of the recent works on nutrition append caloric tables. The caloric value of the protein content is entered also after each portion. The sum of all calorie amounts entered should be equal to the person’s weight times twenty; addition of all protein calorie amounts should total about one-tenth of the first sum. If the actual readings are too far away from those anticipated, the quantities of food should be changed.

One’s estimation might begin somewhat as follows:

<table>
<thead>
<tr>
<th>An example</th>
<th>Size of portion, pound</th>
<th>Calories per pound</th>
<th>Calories per portion</th>
<th>Protein per cent</th>
<th>Protein calories per pound</th>
<th>Protein calories per portion</th>
</tr>
</thead>
<tbody>
<tr>
<td>For breakfast:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pork sausage</td>
<td>½</td>
<td>2030</td>
<td>254</td>
<td>13.0</td>
<td>260</td>
<td>32</td>
</tr>
<tr>
<td>Potatoes</td>
<td>¼</td>
<td>378</td>
<td>95</td>
<td>2.2</td>
<td>44</td>
<td>11</td>
</tr>
<tr>
<td>Toast</td>
<td>½</td>
<td>1385</td>
<td>173</td>
<td>11.5</td>
<td>230</td>
<td>29</td>
</tr>
<tr>
<td>Sugar for coffee, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“Calories per pound” are stated in caloric tables, and “calories per portion” are $\frac{1}{2}, \frac{1}{4}$, etc. of the calories per pound, according to size of portion. “Protein per cent” or else “protein grams” or “protein calories” is stated in table. Many give protein figures in percentage rather than in calories, in which case a rough but workable caloric value is this
percentage of 2000, as straight protein yields nearly 2000 calories per pound. If the protein content is given in grams, the caloric figure is four times this, as each gram of protein yields 4 calories. "Protein calories per portion" are the proper fraction of the figure in the preceding column. Only the two columns giving "calories per portion" and "protein calories per portion" respectively are to be added.

**Adulteration.**—Adulteration of foods might in some instances affect health by upsetting the planned balance of a diet. A cereal used to adulterate sausage is itself a healthful food, but it does not have the food properties of meat. Such adulteration is obviously so well tolerated a hazard as not to harm the average person at all. The adulteration of foods marketed for the use of babies or invalids is more menacing; a weakened digestion which can tolerate arrowroot flour better than the cheaper corn flour, might be adversely affected by a substitution of corn flour for the other.

The practice of mixing cheap foods with expensive is objectionable only if there is deception about it. The marketing of canned preparations of skimmed milk and coconut oil is no menace to health, and it yields a wholesome, palatable, and cheap food. Imitation butters, which consist partly or wholly of fats cheaper than that of milk, have as great food value as butter; only the taste is inferior. Persons in straitened circumstances might be able to afford a greater quantity of these substitutes than of the higher priced articles and so to get a greater health value from them.

**Summer Diet.**—A diet containing too much nourishing food leads to overweight, and in summer to an excessive heating of the body. A summer diet too full in protein and other fuel foods may overheat the body and increase sweating and other discomfort. Metabolism is slower and requires less fuel in warm than in cold weather. An unabsorbed surplus of food is to some extent decomposed in the bowel, with production of heat. The too nutritious diet leads also to increased weight, which is most undesirable in the hot weather. The best summer diet contains much vegetable and fruit, and relatively little of the highly nourishing foods.
A diet of this type tends to counteract overheating and to reduce weight.

**Obesity.**—Overweight results very largely from an allotment through inheritance of a great amount of fatty tissue, but a definite reduction can always be effected. Excessive overweight taxes the circulation during middle or old age, and appears to lessen the chance of long life. For men, dressed, a roughly average weight in pounds is 115, plus four times the number of inches in height above 5 feet, plus 7 if over twenty-five years of age, and plus another 7 if over forty; women average several pounds less.

Weight is reduced by cutting down the amount of fat which goes into the fatty tissue, and by converting into energy the fat already there. The fuel consumed by frequent and strenuous exercise must come from the body’s store of fat, if the diet is low in fuel food.

**Anti-fat Diet.**—The diet for obesity should have both the fat foods and the carbohydrates limited. Excess carbohydrates would not only supply energy and spare the body’s fat, but would themselves be converted in part and added to the fatty store. Rather than simply omitting such foods, it is better to substitute others which afford comparatively little nourishment. The anti-constipation type of diet may be approximated, except that starchy and fatty foods are more restricted, and protein foods perhaps less so. Besides plenty of fruits and coarse vegetables, a moderate allowance is permissible of eggs, lean meat, and skimmed milk or buttermilk. Bread and butter are to be taken only in very limited amount, and potatoes not at all. Cream, sugars, and sugary desserts are to be entirely excluded from the diet.

**Underweight.**—Underweight or malnutrition is given a precisely opposite type of management. Such strenuous exercise as would use up the tissue fats is to be avoided, and a diet rich in fuel foods encouraged. Milk and cream mixture, taken regularly at meals and at bedtime, is an ideal drink for increasing the weight; milk fats are tolerated in considerable quantity as a rule without digestive upset. Cream, and similarly butter, supplies the tissues with needed fat.

The general diet should be liberal. Cooked cereals with
plenty of cream and sugar, potatoes, rice, peas, eggs, and other foods of high nutritious value are given preference over others. A regularly good appetite is encouraged by the avoidance of too frequent eating and of monotony in the diet. One objection to malnutrition is that it reduces the resistance to tuberculosis; this applies most strongly to those in the early period of life.

**Deficiency Disease.**—Some dietetic faults quite apart from the supply of tissue building material and body fuel have to do with the content of so-called vitamins in the diet. These elements are widely distributed, and are contained in the raw foods used for almost any diet, but they are diminished by preserving processes and to some extent by cooking. Absence of all raw or fresh foods from the diet has led often to nutritional disturbances termed *deficiency disease*.

Sailors formerly sometimes developed scurvy after living throughout a long cruise on dried and otherwise preserved foods. Scurvy is a disease characterized by pallor, weakness, sponginess and bleeding of the gums, and pains in the joints. Babies may develop scurvy due to the milk of their feeding being boiled, pasteurized or preserved. An allowance of orange juice provides them with the needed vitamins and is a preventive.

Pellagra, a digestive disease accompanied by reddening and harshness of parts of the skin, has also been thought by many to result from a lack of vitamins in the diet. A similar deficiency has been held partly accountable for the development of rickets, a disease of infancy in which parts of the skeletal system become inflamed.

**Vitamins.**—Different vitamins combat different disorders. There are probably many of them, and three have been clearly defined; of these three, the solubility in fat or water, the stability under action of heat and chemicals, and the nutritional properties vary distinctly. One of these combats a form of ophthalmia and possibly rickets, another beri-beri—a disease prevalent in the Orient—and the third scurvy. The study is too incomplete for clear definition, as regards either composition or mode of action of the vitamins; the present evidence shows little except that certain diseases, or
other less clearly defined conditions of malnutrition, might develop if the respective vitamins were not present in the food eaten.

Some foods have a greater natural content of vitamins than others. Tomatoes, composed almost entirely of water and plant fiber and with a minimal value for tissue building or fuel, are yet quite valuable due to the high content of vitamins. Tomatoes retain much of this content even after canning. Beans and peas are rich in vitamins, as are many other cooked foods. The need of foods exceptionally rich in vitamins, or of some raw foods, should be kept in mind by individuals who are forced to subsist on an unnatural kind of diet. All such diets as most people relish are pretty sure to have sufficient. There is no reason to think that people on an ordinary, appetizing diet could attain additional health or vigor by supposed vitamin medication, in the form of yeast-eating or otherwise. A natural, fresh diet cannot be improved on in respect to vitamin supply.

Mineral Salts.—Various mineral salts are required by the tissues. Table salt is added to nearly all diets, as raw food matters have less sodium chloride than the tissues need. More of this than of any other inorganic salt is necessary in the body fluids. There is also a heavy demand for salts of lime, a principal constituent of bones and teeth. Pregnancy and some inflammatory disorders draw heavily on the body’s stock of calcium, and the latter is supplied by a disintegration of bones and teeth unless provided in large amount by the diet. Foods rich in calcium are milk, cheese, yolk of egg, spinach, peas, beans and many fruits.

Iron salts are concerned in the formation of red blood cells and other tissues. The pallor brought on by many diseases indicates a falling short of the body’s supply of iron. A pallor, or anemia, is combated by eating foods rich in iron, and sometimes by taking iron salts themselves. Iron is plentiful in almost any common diet; among the foods which have a considerable content of it are yolk of egg, spinach, most other greens, molasses, prunes, raisins, whole wheat, oats, peas, and beans.
Flavors and Extractives.—Flavoring substances and extractives, though not in themselves nourishing, stimulate the appetite and in moderation add much to the normal diet. Clear meat broth is a solution of extractives and supplies little to the tissues besides water, but it finds a place on many tables. These substances and the condiments stimulate the flow of digestive juice and probably have additional minor influence.

Clinical observations suggest that an excess of the extractives tends to raise blood-pressure and to irritate the kidneys. It is supposed to hasten the process of arterial hardening and of interstitial nephritis, or sclerosis of the kidneys. Spices and condiments, or an excess of protein, are sometimes thought to have a similar effect. Specific knowledge of this is scant, but it can be said generally that the habituation to an excessively rich, highly spiced, and highly flavored diet, especially after middle life, is often associated with this class of disorders.

Taste.—The body makes one more demand of the diet which is rather less subject to specific definition than the foregoing. The diet is to attract the appetite. The taste offers some inexplainable yet tangible indication of nutritional demands. Many substances must be supplied to the tissues and their proportion varies in different foods. Some of the fuel must be fat; proteins must embrace certain amino-acids. A monotonous diet or one which does not attract the appetite is likely to be rather short on some food element for which the tissues are calling. However wholesome a meal may appear on paper, it is unsatisfactory for those with delicate nutritional tolerance unless it is also appetizing. In tuberculosis, for instance, the nutrition can be maintained only by a good, full diet, and non-appetizing or too monotonous meals can be eaten only sparingly.

The taste is not to be given too much preference over the other requirements, because taste discriminates most unreasonably in favor of sugars. This may possibly be because sugars are disposed of more easily than other foods, and with less work by the digestive tract. Inactive people who yield too greatly to their taste are likely to eat too much candy
and sweets, and as this meets their energy requirement they neglect the foods with vegetable fiber and protein. The development of pallor, indisposition, constipation or overweight eventually results.

Infant Feeding.—Babies frequently suffer from a diet too rich in sugar; the latter goes into fat, and as parents desire a fat baby the sugary feedings become popular. This diet makes them fat and pale in appearance, and lowers their resistance to diarrheal diseases and various infections. The formulæ on infant feeding packages too often suggest a feeding overrich in sugars, the sugar being part of the package’s content. Use of the sweetened condensed milk sold for babies feeds excess sugars to them.

Feedings with cow’s milk as a basis should be so estimated as to give proper fuel and protein values. Some sugar must be added because cow’s milk has less sugar naturally than the baby’s ideal food, which is breast milk. Babies do well on ordinary cane sugar as a rule, but there are exceptions. The sugar best tolerated by the infant’s digestive system is dextri-maltose; strangely enough, this is less disturbing than milk sugar. In making up the formulæ, the proportions of milk, sugar, and water are gauged according to the age and weight of the baby.

Caloric Formulae.—The baby requires a higher caloric allowance per pound weight than does the older person, on account of its very rapid growth. Instead of the 20 calories per pound weight, allowed adults, the baby is given 40 or 45. It is given about 15 per cent, or 6 calories, of this in protein instead of the 10 per cent provided for in diets for adults. Cow’s milk contains protein enough to yield about 4 calories per ounce, so the proper protein allowance per pound weight daily is in $1\frac{1}{2}$ ounces of milk. This pound weight allowance of milk gives a total fuel value of about 31 calories, as milk yields approximately 21 calories to the ounce. Sufficient sugar is therefore added to bring up the total from 31 to the 40 or 45 required, or enough to yield about 11 calories. A level teaspoonful—about $\frac{1}{16}$ of an ounce—of most sugars yields something like 11 calories, and this is the desired addition per pound weight.
To the day’s feeding, containing $1\frac{1}{2}$ ounces of milk and a teaspoonful of sugar to each pound of the baby’s weight, is added enough water to make 5 or 6 feedings, each as large as the baby can take. There are 6 daily feedings at equal interval for the first month or so, after which the number is reduced to 5 by lengthening the interval at night from four to six hours. After eight or nine months the night feeding is put forward to permit eight hours of uninterrupted sleep. The total amount of each feeding is worked up to $2\frac{3}{4}$ ounces by a week or so from birth, after which it increases by 1 ounce each month for three months, and after that $\frac{1}{2}$ ounce each month. These quantities contemplate the filling of the stomach and the passage of an extra ounce into the intestine during the feeding.

A four-month baby weighing 11 pounds has, for example, 5 feedings daily, each of 6 ounces, or a total daily amount of 30 ounces. Of this $16\frac{1}{2}$ ounces—weight times $1\frac{1}{2}$—are milk, and the $13\frac{1}{2}$ ounce remainder water. Of sugar is added 11 level teaspoons—weight times 1. This computation is easy and gives a much better approximation of correct food values than do most of the formulæ which advertisers bring into the hands of mothers.

Strictly accurate computations, such as would be made by the pediatrician, are obtained by summing up total calories of the day’s feeding, as was described for the mixed diets of older persons. Many of the leading pediatricians continue to estimate formulæ on a percentage basis, in preference to the newer caloric basis.

Drinking water is given about midway between feedings if the baby is awake; babies are awakened for the feeding but not for water. The water is boiled, unless known to be free from germs. Even greater care is to be taken that the baby’s milk is free from germs. Market milk in many localities is highly contaminated, and is safe as an infant food only if pasteurized or boiled in the home. As the heat tends to destroy vitamins, the baby should be given a teaspoonful of orange juice between feedings.

The amount of cow’s milk is increased up to but not beyond 1 quart daily; beyond this point the food values are increased
by solid foods. At any time during the last half of the first year, cereals may be added; in the last month or so they are needed, in order to fill out the measure of fuel food. Some pediatricians advise the addition of some other vegetable foods as well, late in the first year. Meat is deferred until later babyhood, when stomach acidity for the activation of pepsin develops.

The diet during the second year is gradually broadened to include toast, soups, well cooked vegetables, and fruits. During the third it increases to a fairly general diet of three meals a day, but exclusive of the less digestible articles such as pork, fried foods, highly spiced foods, and pastries. The pound weight allowance is continued at 40 calories for three or four years, after which it is decreased each year by about 1 calorie. Tendencies to constipation are combated by fruits and vegetables as before outlined for the adult.

**Dietetic Errors.**—The dietetic measures outlined in this chapter are those which prove most compatible with normal nutritional functioning. The average human machine can tolerate much variation from this, and is likely to get along well in spite of abuses. Many people on queer diets retain such manifestly good health that no change is even to be recommended. It is the baby, or the person who is underweight, or the one troubled in some way with his digestion, who needs to have the diet most carefully regulated.

**Reading.**

*General, Lee, Chapter II.*

*Physiology and Hygiene of Nutrition, Hough and Sedgwick, Chapters XIII and XIX.*

*Classes of Foods, Dietaries, etc., Woodman and Norton, Chapter VII.*

*Food Values, Sherman, Chapter XIV.*

*Overweight and Underweight, Fisher and Fisk, Supplementary Notes, Section II.*

*Vitamins, Mathews, Chapter XX.*

*Nutritional Disease, Winslow, Chapter XVI.*

*Infant-feeding Formulae, Grulee, Chapter XI.*

*See bibliography for titles and publishers of books.*
SENSATION AND MOTOR CONTROL OF THE BODY.

Nervous System.—The brain and spinal cord connect with and control the activity of other organs, by means of nerves. The cells of the nervous system have irregularly shaped bodies which extend out into long fibers; the fibers are highly conductive for impulses of various kinds. Many fibers (dendrites) gather and conduct impulses into a cell body, and one of a different sort (axon) carries the impulse out. The exact nature of nervous impulse is unknown.

Gray matter, which constitutes the outer layer of the brain and the inner portion of the spinal cord, consists very largely of the nerve cell bodies. The white matter, which forms the brain’s interior, the cord’s exterior, and the nerves, is mainly a mass of the fibers.

Types of Impulse.—The nerves themselves are long bundles of the fibers; their function is to transmit impulses, which are of two types. Fibers of sensory nerve cells bring to the brain or cord such impressions as to show what activity is desirable for an organ. These fibers terminate in end-organs peculiarly adapted for the picking up of impulses. Fibers of motor cells take back from the brain or cord to the organ some impulses to cause the desired activity. It is only through motor impulse that any muscle contracts, and that some of the glands secrete. This regulates the activity of the body to accord with the demands. The nervous mechanism harmonizes the functions of the body.

Reflex.—A nerve cell cannot function independently. An impulse needs at least two cells, one to gather up the impulse and another to send it on as an activating force. The functional unit of the nervous system may be regarded as the combination of a sensory and a motor cell (simple reflex arc).
The simplest of the nervous activities are those of a purely reflex type. One does not become conscious of accidentally touching the lighted end of a cigar, but he becomes conscious of just having touched it; he jerks away by the reflex nerve action before the realization of pain comes.

![Reflex arc diagram](default)

**Fig. 17.—Reflex arc.**

The reflex of two cells does not play any large part in the human nervous system. Man's reflexes are more complex, in that a series of more than two cells is concerned in any activity. The impulse passes over a complicated chain of cells before its final transmission to a muscle. Furthermore, each reflex functions in correlation with others, rather than by itself. Many sensory impulses influence one motor action.

**Senses.**—Senses are conscious reactions to certain sensory impulses. They may arise either from naturally recurring impulses or from impulses which occur because of abnormal conditions. We speak of a sense of sight, and a sense of pain. This sensory apparatus, for the most part, develops and functions normally without the need of hygienic effort. In some instances its development is not independent of such effort. Intensive training of sensory tracts in the brain heightens a capacity for sensing—the increased auditory power of blind persons, and the gustatory power of trained tea tasters, are examples.

The functioning of a few of the senses can be improved through hygienic aids, to be directed in some cases to the sensory nerve elements themselves and in others to accessory tissues. Senses may need protection from too powerful stimulation. Attention must more frequently be paid to the
condition of the organs which bring vibrations to the nerve endings. Most cases of deafness or blindness would be preventable through care, not of the nervous tracts, but of the accessory organs.

**Hearing.**—Life in a noisy place might aggravate a neurotic tendency, for the reacting nerve elements tire if a sound of monotonous pitch is too much prolonged. Entirely normal persons also suffer from excessive noise, though not so much. The disposition is often upset thereby and productive thought made impossible. Sleep too is interfered with. Frequent disturbance to slumber, due to the room not being kept quiet, leaves a distinct mark on the mental health of babies and children.

A much greater health consideration of hearing has to do with ailments of outer or middle ear. These organs transmit sound waves to the end-organs of hearing in the internal ear. The three sections of the ear are walled off from each other by membranes, which prevent most of the disorders of one from affecting also the others.

**External Ear.**—The external ear serves only as a canal from the outside. It terminates with the drum membrane, separating it from the middle ear. It is lined with skin, in part of which are hairs and hair follicles. The common disorders are infections about the hairs and a plugging up of the canal. The former is suggested by tenderness of the ear to manipulation, without difficulty in hearing. The latter is suggested by a stuffed up sensation, with some impairment in hearing and without pronounced ache or pain.

An excessive accumulation of the waxy secretion which forms in the external ear may entirely close the canal. Apparent persistence of water in the ear after swimming may be the first suggestion of it, for water swells the wax. Wax can usually be washed out with a stream of warm water; some prefer water with a little baking soda dissolved in it. The ear is held downward and the stream from a bulb syringe directed upward into it and allowed to drain back freely. Accumulations so hard as to require scraping out should not be worked on at home, but only by a physician.

Foreign bodies should also be removed by a physician,
unless they can be shaken or dropped out; unskillful poking about in the ear is likely to drive them farther in. The foreign body may be an insect which would itself crawl deep in; insects cause an excessively irritative sensation, rather than the symptoms just noted for lifeless objects.

**Middle Ear.**—The middle ear opens through the Eustachian tube to the throat. Under certain conditions the tube swells shut and by disturbing the air pressure in the middle ear causes a sensation of stuffiness and an impairment of hearing. One such condition is the common cold; this is of course temporary and of little significance. More permanent types of impairment result from the extension of inflammatory conditions through the tube to the middle ear. A catarrhal inflammation there, involving different structures in such wise as to impede their functioning, is not uncommonly associated with adenoids or chronic inflammation of the throat.

The more acute type of middle ear disease, by an extension of pus infection through the tube, has been mentioned. Many cases of defective hearing originate with such infections, frequently that which complicates scarlet fever. The different affections of the middle ear have left a few of every hundred persons with some hardness of hearing in both ears, and a much greater proportion in one.

Acute infection of the middle ear reveals itself by fever, earache, difficulty in hearing, and sometimes running ear. With running of the ear the danger diminishes. If the drum membrane remains intact and prevents drainage through it, the pus is more likely to force its way into the mastoid cells behind. The resulting infection there, *mastoiditis*, requires extensive surgical work, or may lead to fatal complications. Middle-ear disease should be treated at once by a specialist, who will if necessary lance the drum; this operation does not affect the hearing, as the opening rapidly heals when the pus formation subsides.

**Vision.**—Disorders of vision are likewise of the accessory apparatus rather than of the nervous mechanism of sight. The eye is a camera whose box, or *sclera*, is nearly spherical and consists of dense, tough fibrous tissue; it has a circular
transparent outer lens (*cornea*) in front. The sensitive screen on which the view is reproduced is called the *retina*; the latter together with the choroid membrane lines the sclera, except in front. The visual purple in the retina, a substance analogous to the chemical coating on the camera film, is bleached temporarily by the light rays. This reaction of the light, together with others, stimulates certain cells (*rods and cones*) at the reacting points in the retina, each of which connects with an optic nerve fiber passing to the brain. In this way the entire picture sends its impression to the brain for perception.

**Accommodation.**—Projection of an image on the retina requires a focussed lens. A view is reproduced in the eye only if the light rays from any given point in the view can be focussed to a corresponding point on the retina. A stronger lens is required to focus rays from a near-by than from a distant object, for the distance from lens to retina is fixed. A muscle of accommodation varies the strength of an internal lens to provide for this. The lens is firm but yielding, and is elastic. It hangs by ligaments from structures at the anterior margin of the choroid membrane, situated between sclera and retina.

**Eye-strain.**—Eye-strain is a term applied to the weakness (*asthenopia*) which results from an overtaxing of muscles concerned in vision. It is spoken of as *accommodative* when it involves chiefly the muscle of accommodation within the eyeball, which regulates the curvature of the inner lens. This is a ring of muscle (*ciliary muscle*) attached to the inner surface of the sclera, around the outer lens. From this front attachment, the fibers radiate backward into the eyeball and so attach posteriorly that by contracting they pull forward the choroid membrane which supports the inner lens. This loosens the attachments of the lens, and allows the latter to swell by its own elasticity, to become more convex, and to focus nearer objects on the retina. It is therefore near vision which taxes the muscle; contraction is for near-by and relaxation for distant focus.

Strain is sometimes termed *neurasthenic* when it is part of the weakness of a neurasthenic complex; this complex
Sensation and Motor Control of the Body

will be discussed later. The strain is spoken of as muscular when it involves the muscles in control of the direction of gaze.

**Squint.**—Muscles in the socket, outside the eyeball, are so attached that their contraction rolls or turns the eyeball. The strongest are those on the medial side of the two eyes, which turn the eyes inward to permit vision by both of one object. Near vision adds to the contraction demanded of these medial muscles, and an overtaxing of them is a common form of muscular strain.

Squint (strabismus) is due to some fault of the external muscles of the eye; it may assume different forms. Commonest among these is the convergent squint, or crossing of the eyes. Double vision is avoided by an unconscious suppression of sight in one of the eyes, with eventual blindness in it. Sight can sometimes be preserved to both by the alternate covering of first one and then the other eye until operation is feasible; the place of attachment of a muscle is then changed surgically and the direction of gaze thus brought to normal. The milder defects of these muscles can often be overcome by corrective exercises. Cases should go as early as possible into medical hands.

**Symptoms of Strain.**—Headache is a symptom suggestive of eye-strain. There occurs also a sense of fatigue about the eyes, and sometimes an itching of the lids or muscular twitchings. Occasionally there is dizziness, double vision, or nausea. The close worker might as well stop when such symptoms assail him, for with eyes in this condition the progress would be too slow to compensate for the injury done. Rest for the muscles is by their relaxation with distant views, or by lying down and closing the eyes. The tendency of school children to gaze off into space is in part an unconscious attempt to rest the eyes.

**Causes of Strain.**—Prevention of strain is by avoidance or correction of the various causative factors. Strains result most largely from defects in the curvatures of the lenses or of the eyeball. They may also result from excessive near vision, poor definition of the objects studied, or shifting or bad position of the object. Poor definition of an object, often
due to small size of the print being read or to reflected lights from highly glazed paper, exacts such close focus to get a maximum impression on the retina that the muscles suffer. The bad relative position of an object sometimes strains the eyes of one reading in bed, or the shifting about of the object strains those of the person who reads in the train. Such abuses as these tire the eye quickly, and are likely to overtax and strain one with inherent imperfections.

Refractive Error.—The refractive defect which interferes with sight at close range, generally called far-sightedness (hyperopia), is such a misshapening of the eyeball as to bring near objects to a focus behind the retina, unless the muscles of accommodation contract excessively to shorten the focus. Another defect is of the curvatures of either cornea or inner lens, the segment of an ovoid rather than a spherical surface being assumed. The refraction of one meridian of such an eye differs from that of another; the eye focussed on one line does not focus on another line at right angles to it (astigmatism). Clear vision in this case requires an irregular accommodative contraction, and this may strain the muscles. These and other refractive errors are the commonest cause for strain of the eye muscles; they are corrected by supplementary lenses, in the form of glasses.

Such defects, even though hereditary and present from birth, do not often become evident until the child reaches school age, with its added requirement for close work. One or two school children in every ten need glasses, and without them their eyes and their studies suffer. The eyes of a child who, at a distance of 20 feet in a good light, cannot recognize with each eye separately a very heavily drawn design \( \frac{1}{3} \) of an inch high, should be examined by an oculist. The occurrence of headache, aversion to reading and reddening about the eyes should not be waited for, before having the eyes examined. Only the physician who has made special study of the eye can be relied on for the fitting of glasses; many incompetent persons pretend to be qualified to do this work.

Visual Aging.—Too much near work by the very young is said to alter permanently the yielding tissues of the eye.
Near-sightedness (*myopia*) has been attributed in some cases to very early school work. Close work should not be done in kindergarten. The reading of ordinary book print should be deferred until the seventh year or later, and any reading before this done from large charts.

As age increases, the tissues become more and more firm. The lens gradually hardens, until at about forty-five years of age it has largely lost its elasticity. It does not then respond to the loosening of its attachments in accommodation, and near vision requires the use of reading glasses. It continues its hardening, and as it hardens contracts and increases its curvature. When old age is reached the lens in many instances no longer fociusses for distance but does for reading, even without accommodation; this is the phenomenon of "second sight."

**Excessive Glare.**—The choroid membrane contains the supply of vessels for the nourishment of the retina and lens. Being heavily pigmented and opaque, it also serves to keep the interior of the eyeball dark; no light enters except that through the pupil. Anterior to the choroid is the iris, which has similar pigmentation. The pigment in some persons, particularly blonds, is insufficient to protect the retina from the glare of tropical and subtropical regions, or from that of white expanses of snow. The eye is strained by the spasmodic attempt of the iris to reduce the pupil and shut out the light. In addition there are irritative effects from the excessive ultra-violet ray in such strong light. Sun glasses afford the logical protection from glare; they are required only by those in whom the light causes discomfort or other symptoms.

**Pain.**—Senses for the perception of bodily disorder are often so unpleasant as to be carelessly regarded as diseases; instead they are symptoms of disease. The management is primarily of the disordered tissue from which the nerve arises; as in the case of defective vision and hearing it is not of the sensation itself. An ache or pain is to be relieved, of course, if it can be done harmlessly, but this is secondary to the treatment of the causative disorder.

The pain from a wound is made worse by the stirring up of crushed tissue, and the first aid given should guard against
such excitation. An eyelid with a cinder under it is eased if held shut by the pressure of a pad until the cinder can be removed. Digging of the broken ends of a fractured bone into surrounding tissue may pain to the point of shock. The patient should not be lifted about until a board, stick or other temporary splint can be bound alongside the injured member. In addition to supporting the part for rest, the application of heat, or sometimes of cold, offers relief. Hot-water bags, or cloths wrung from hot water, are put over the pained organ. Cold application serves the same purpose, but is usually less effective.

**Analgesics.**—Liniments, medicated plasters, and drugs taken by mouth, while of value in some cases are useless or even harmful in others; none are recommended for indiscriminate use. Continual crying by the baby is a matter for the physician, not for paregoric or soothing syrups; these depend for their effect on opiates or other undesirable drugs. Aspirin (*acetylsalicylic acid*) frequently relieves aches and is less injurious than most other drugs taken for the purpose. Small doses do no harm to one whose heart and circulation are normal; mild gastric symptoms occasionally follow. The dose is 3 to 5 grains, taken once every few hours until the ache subsides. Those who accustom themselves to the drug get no effect except by much larger doses.

**Narcotics.**—The smallest doses of habit-forming drugs, such as the derivatives of opium or coca, are harmful in that they create a craving for more. Somebody has suggested that the tissues must form in excess a resistive substance to the drug, and that this substance happens to have a peculiarly irritant effect on the body until neutralized by more drug. The craving increases rapidly, and subsides only very slowly when the drug is later abstained from. Drug users are withheld from cure also by loss of mental efficiency and will power; the drugs gradually destroy mental faculties of the habitués. Only exceptionally can cases do brilliant thinking while under narcotic influence, though much fiction has been based on the supposition of such brilliance; the exceptional few have corresponding periods of depression afterward.
The drug habit is not infrequently acquired through the use of morphine being continued for weeks to control pain. Lovers of excitement take it up too, simply as a new thrill; for them, it starts perhaps with a wild party, just as other forms of dissipation might. A feeling of exhilaration is produced at first, which helps the habit to become established. Later this feeling is wanting, but by then there is the craving. Gradually there appear nervous twitchings, restlessness, constipation, loss of weight and other symptoms. Marked symptoms are in some cases noticeable after a period of months, and in others only after many years. Some are affected much less than others, as individual resistance varies.

**Headache.**—The aching discomforts which are most commonly treated at home are those of head and of back. Headache occurs as a symptom of many disorders, the recognition of which is the first essential to treatment. The logical remedy for one headache would do harm in other cases. Causes of headache are sometimes classified as toxic substances in the system, general circulatory disorders, inflammation about the head, pressure within the skull, inherent nervous qualities, and reflex.

Toxic headaches are those due to fevers, drugs and possibly constipation. The toxins due to febrile disease are less easily avoided than those which come from an excessive use of tobacco or coffee, or from overeating; in all, an avoidance is the key to control. Rest in bed and cold application to the head often gives some relief. The headache associated with constipation has long been attributed to toxic substances, though some recent evidence throws doubt on this; treatment is of the underlying constipation, as outlined previously.

**Headache Powders.**—Headache powders, or even aspirin, give temporary relief, but they do not tend to cure and they may aggravate the headaches due to the second group of causative factors. Such circulatory conditions as high blood-pressure, anemia, or heart defects may be adversely affected by any of these preparations, unless given carefully under the supervision of a physician. Many of the proprietary headache medicines are harmful in themselves, regardless
of the patient's circulatory condition; those of an unstated composition are in no case to be trusted.

The surgeons in charge of local inflammations about the eyes, sinuses, ears or teeth, usually allow aspirin or other similar drugs for the control of the aching; it is inadvisable to take a dose before consulting the surgeon, as the symptoms might be masked and the diagnosis interfered with. In these cases and in those of brain tumor or other intracranial conditions which cause headache, a physician would be in charge anyway and home remedies not thought of.

*Sick Headache.*—Eye-strain and pains along the nerves (neuralgia) often cause headache reflexly. Many of the headaches at first ascribed to constipation, biliousness, or overtiring, are relieved by the wearing of properly fitted glasses. The attacks popularly referred to as sick headache or "migraine" might fall in the same class; they are not of uniform causation. Each individual case needs medical study.

The true migraine headache is due to an inherited trait. This occurs most frequently in women; it tends to be worst in the first half of life and toward middle life to subside. Little can be done for it, except the control of attacks as they come. Medication with aspirin, in conjunction perhaps with allied chemicals, may abort the attack if begun at the earliest sign of its approach. Visional disturbances often precede the headache itself, and the treatment should begin with these first symptoms.

**Backache.**—Backache occurs as a result of toxic action, especially in infectious disease, of skeletal disorders about the back and pelvis, of disorder about the viscera, or of local affection of muscles or nerves in the back. Until the determination and correction of the cause is possible, relief is best afforded by rest in bed and sometimes by application of heat.

The toxic backache accompanies a corresponding toxic headache, and is managed similarly. Causative skeletal disorders are sometimes inflammatory, those caused by rheumatic arthritis or tuberculosis for instance. Sometimes they are strains of the ligaments by bad posture, overexertion or mechanical injury. Abdominal or pelvic viscera with
faulty suspension, resulting in visceroptosis or uterine malpositions, may drag on the supports and cause backache. Backache is not commonly a result of kidney disease, as some advertisers of pills would have us think.

Dizziness.—A sense of dizziness (vertigo) indicates a disturbance to some part of the mechanism of equilibrium. Sea-sickness results from an overtaxing of this mechanism. Dizziness results also from physical disorder of the organs of equilibrium, of the semi-circular canals near the inner ear, an organ of equilibrical sense, or parts of the brain. Arterial hardening in old people not infrequently involves the vessels of the brain, and dizziness may occur as an early symptom; heart defects or anemia similarly cause dizziness. The rapid growth of youth is sometimes associated with attacks, due to the instability at that time of the vascular tone. This condition in young people has little significance, but in older people a more serious circulatory disturbance is suggested.

Body Equilibrium.—Much of the sensory impulse leading to motor activity comes through the conscious senses. The body’s equilibrium requires just so much activity in each of the many muscles. To maintain it, an accurately gauged force of impulses must be distributed among the various motor nerves. This distribution would vary according to whether the individual were standing in a room, in a street car, or in a wind storm. The central nervous system is put in touch with these outside conditions by sensory nerve impulses, on which depends the distribution of the motor impulse.

Sensation of equilibrium, from the semi-circular canals, tells of any tilting motion of the floor beneath. Sight has additional influence, as does hearing and other sensations. There are sensations from the muscles, called deep muscular sensation, which are carried up to the brain through certain tracts in the spinal cord; they show the existing state of muscular contraction. Tabes, or locomotor ataxia, is a syphilitic infection of these tracts in the cord; the incoördination characteristic of the disease is due to the cutting off of these deep muscular sensations. All the sensory impulses are transmuted
into motor impulse, coördinated, and sent to the proper muscles to maintain equilibrium.

**Vital Centers.**—Other motive functions of the body require nervous impulse much more constantly than does the skeletal musculature. The heart, for instance, must have a continuous series of impulses. Such impulses come from a group of *vital centers* in the lowermost segment of the brain, which are supplied with their sensory stimuli automatically. Centers in control of breathing and of heat regulation were alluded to in an earlier chapter.

Another center regulates the contraction and dilation of bloodvessels. This one sends its motor stimuli through the vasomotor nerves to the muscular coats of the bloodvessel walls. Vasomotor impulse may dilate the vessels of the viscera and take the blood largely to the abdomen, or it may bring the blood to the surface of the body by contracting the visceral vessels and dilating those of the skin.

**Consciousness.**—Increase of the blood circulation about the brain is by the forcing out of blood from the skin and viscera, rather than by active dilation of the brain's own vessels. For consciousness the brain requires a rich supply of blood; if the supply is reduced drowsiness or even unconsciousness results. As other organs can actively draw blood from the higher centers of the brain, and not *vice versa*, conscious activity depends in part on the care given these other functions. Mental work is retarded in an excessively heated room, because the blood is taken into the skin for elimination of heat, and particularly after a heavy meal when the blood is also being drawn so greatly to the digestive tract.

The blood's unaccustomed call to the surface by the weather's warmth might cause much of the drowsy "spring fever" symptoms. This explanation, or anything else we know of the causation of the early summer languor, would not lead us to expect results from the popular treatment with spring teas and spring tonics. The latter are laxative and for reasons already set forth are better avoided; the former supply the system with nothing of value but water. Sweetened "sassafras tea" or infusions from other plants might attract children more than water would, but they have no other hygienic advantage.
Fainting.—Several forms of unconsciousness are due to a reduction of the blood supply to the brain, among them the common fainting spell. Fainting is especially likely to occur in those with a constitutional circulatory instability; it is a tendency of early life which is later outgrown, and there is nothing serious about it. Excessive emotion interferes with circulatory regulation and may lead into a faint. Nothing need be done for an attack; the person comes out of it anyway. It is better to leave the patient where he falls than to set him up, as the gravitation of blood into the head has its advantages.

Unconsciousness.—A person found unconscious is better not dealt with too actively until the cause for the unconsciousness is learned. Accompanying convulsions, particularly if there is laceration of mouth tissues, suggests epileptic fits as the cause of unconsciousness. The hysterical convolution is sometimes similar but would never lead to injury of tissue. Or an alcoholic odor may give the clue. The possibility of poisoning is to be considered, and containers for poisonous chemicals might be looked for. Inspection of the eye may show the small, contracted pupil of opium poisoning, of which very slow breathing is also suggestive.

Marks indicating a blow on the head suggest concussion of the brain or bleeding within the skull. Hemorrhage causes the unconsciousness in both these conditions, that of concussion being into the brain tissue from many small bloodvessels, and the other type being from larger vessels into the brain chamber of the skull. Old age of the patient, and evidence of physical or mental exertion shortly preceding, suggests hemorrhage from some hardened and broken artery about the brain (apoplexy). Unconsciousness results from the want of blood supply to the cells, due to the pressure of the escaped blood against brain tissue.

Aid to the unconscious consists in first laying the patient flat and loosening the clothing about the neck. If the patient's skin seems cold, or if he is in collapse from accident or any other cause, he should be covered well with clothing or other materials; chilling is one causative factor of shock. Further measures depend on the nature of the ailment.
The cases for very active treatment are those of poisoning, as outlined in a previous chapter, and of heat stroke, mentioned below. An epileptic should have something placed between his teeth, to protect his tongue from laceration. Persons unconscious from other causes are to be watched but not disturbed too much. Hemorrhage about the brain would be made worse by unnecessary or unskilled lifting about of the patient.

**Heat Stroke.**—Sunstroke (thermic fever; heat stroke) is due to an absorption into the body of greater heat than the mechanism of heat regulation can eliminate. The surplus accumulates and eventually becomes great enough to paralyze the center. Heat elimination then stops and the temperature of the body rapidly rises, the mouth temperature often reaching 110° F. or even higher. The heat slowly kills the brain cells. The only hope for relief is a withdrawal of the surplus heat before the brain tissue suffers irreparably. Ice-water baths, if possible, and an ironing of the body surface with chunks of ice, are the best aid.

An attack of sunstroke leaves a permanent defect in the nervous control over heat regulation; this lowers the subsequent resistance to heat. Alcoholism does the same. In some the resistance of the mechanism is inherently low. Those who do not perspire well are the most likely to resist heat poorly, and should avoid great exposure to it.

**Heat Exhaustion.**—Long exposure to more moderate overheating, as by working in a boiler-room, leads to a very different picture called heat exhaustion. The body feels cold and clammy and its temperature falls as the person goes into collapse; the patient may or may not become unconscious. This is an exhaustion of the circulatory system, apparently overstrained by its part in eliminating so much heat; the person whose heart is itself defective or has a defective supply of nervous driving power is especially liable. The patient is to be warmed up to normal body temperature. Long rest in a properly ventilated room affords gradual recovery.

**Neuroses.**—The nervous mechanism for certain types of activity might in some individuals be defective and inherently inadequate to handle the necessary impulses. Writer's
cramp results from abnormally poor nervous control (neurosis) of the hand muscles; no amount of writing would so affect a normal hand. Ordinary work causes the defectively supplied hand to have its attacks now and then. Similar cramps sometimes suffered by cigar makers or typists indicate unconquerable obstacles, and if too troublesome call for a change of occupation. There are many types of inherent nervous defect, different parts of the system being at fault.

**Stuttering.**—A type which occurs widely among children, and sometimes is not outgrown, is that which leads to stuttering. The speech falls into one monotonous pitch, and for talking at this pitch the muscles are not adequately supplied from the central nervous system. Spasm of the muscles results, with the characteristic disturbance of articulation. While the condition is due largely to the inherent nervous make-up, its development can be checked to a degree by careful hygiene.

Building up of the child's physical condition by the removal of any adenoids, fitting of glasses if needed, outdoor exercise, deep breathing, etc., come first. Mental hygiene, to be outlined in the next chapter, should have even greater care. Excitement or fright, aroused by weird stories or by the watching of such exciting performances as sham battles, aggravates the tendency. Encouragement to singing, and to talking with expression rather than in one monotonous tone, would lessen the tendency. Treatment of a pronounced case of stuttering is best put in the hands of a physician skilled in vocal gymnastics.

**St. Vitus's Dance.**—St. Vitus's dance, or chorea, is a disease characterized by jerking and uncontrollable movements by certain muscles. That of the ordinary type in children (Sydenham's chorea) results when streptococcus infection overexcites a group of motor nerve cells in control of some muscular action. This infection of the nerves complicates a preceding infection, usually of the tonsils, and is preventable and often curable by the removal of any accessible foci of infection. Other children who see and imitate a patient's convulsive movements might acquire a habit of similar activ-
ity, but popular apprehensions lest such a habit develop into the disease are unwarranted. A chronic chorea of older people (*Huntington's chorea*) is one of the hereditary diseases.

**Habit Spasm.**—Habit spasms are similar involuntary and convulsive contractions of certain muscles, frequently of the face, but less wild and jerking. This condition does not result from infection, but is largely inherent. It is associated often with a general neurotic tendency and is most marked during the period of rapid growth. It is outgrown as childhood is passed, with the occasional exception of a quick and involuntary spasm in an eyelid, or of some other muscle. No management is needed beyond that looking to the general health. Any physical defects should be corrected and attention given to mental hygiene.

**Tetanus.**—Tetanus is an ordinarily fatal disease, the most evident symptoms of which are convulsive; the early involvement of the muscles of the jaw is characteristic and affords the popular synonym, lock-jaw. The convulsions result from the action on motor nerve cells of toxins excreted by the germ of tetanus (*B. tetani*); the germ invades wounded tissues and sends its toxins through the blood stream and up the nerves to the central nervous system. This germ is a rod-shaped bacterium, with spores that can remain alive for long periods in the superficial layers of the soil. It develops normally in the intestines of horses. When introduced deep into the tissues by a dirty wound, the spore passes into the vegetative form, develops there and produces its toxins.

Rather than depend on the available laboratory methods for the determination of tetanus bacillus infection in a wound, it is better to play safe and take antitoxin after any wound that is deep and dirty. The antitoxin is needed early if it is to neutralize the toxins before they reach susceptible tissue about the brain. After symptoms have developed, it is in most cases too late for effective treatment. The inability of this germ to vegetate in the presence of oxygen is one point for the dressing of wounds open to the air. Sealing of small lacerations with collodion mixtures, or even with court plaster, interferes with the escape of any pus formed and somewhat increases the possibility of tetanus.
Reading.*

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CHAPTER X.

THE MENTAL PROCESSES.

Mental Hygiene.—The nervous system was described as a central governor for the various activities of the body. This governor is directed into comprehensive relationship with the surroundings by its highest or mental centers. With a wider understanding of the environment, a better position in it is attained. As a perfectly healthy function not only is free from demonstrable disease but also attains its ends, the mind to be considered thoroughly healthy must maintain for the person a proper place in the community.

Physical as well as educative factors contribute to this sort of mental health. Their mode of influence is often somewhat confusing, but can be made clearer by a brief survey into the nature of the mind's workings. The sketchy presentation of the latter here made is not by a psychologist and undoubtedly contains errors; the field is not as yet clearly revealed even to students of psychology. Any errors would probably not be sufficient to vitiate conclusions about mental hygiene.

Mechanism of the Mind.—The apparatus for mental activity operates as does the rest of the nervous mechanism. A concerted action by the body is through the correlation of a number of nervous reflexes. Various sensory impulses of a nursing baby, for instance, lead to the motor combination of sucking. View of the bottle is not a part of this primary correlation of feeding impulses, but a bottle-fed baby learns to associate the view of a bottle with feeding. Then the mere sight of the bottle may start the baby to sucking something. Some cells of the higher centers become a pathway between two formerly isolated seats of activity; in this case impulse in a seat of visional perception passes over to the correlation path concerned with sucking.
Association Paths.—Mental associations, of which the above is an example, are by means of nerve fibers in the brain which connect up other nervous complexes. The chain of nerve cells traversed by an associating impulse, though intricately extended through the higher centers of the brain, controls, as would short reflexes, the course of bodily action. This longer and more involved process excels the shorter one in that its issue is guided from more directions. It may also lead into an activity which profits the more because it first hurts.

The mental process which delays immediate results for protracted deliberation may lead into the better activity, but to do so it must avoid inconsequential musing; the thought to which varied impressions have given rise is of value only as it leads to eventual action. The faculty for transmitting thought into actual doing is will power. This is less a quality in itself than an indication of completeness in any mental process, or of the enthusiasm or determination which would bring it to completion. All sound mental training builds will power. Display of will implies definite action based on existent views and desires, and only in proportion with the soundness of the views is it a virtue.

The supposition that given thoughts or actions always use the same series of nerve cells allows any of them a definite route of travel through the brain. Fibers for some sorts of association group themselves together into demonstrable bundles (association tracts), though the path of an association can be just as well defined when its course is not so readily demonstrable. The forced change of a left-handed person to become right-handed drives the impulse into an extra trip across the brain, and the mental control over manual activity becomes to this extent less direct; observers think that children with a strong disposition to left-handedness are better off so than if trained out of it.

Attention.—Direction of the body's activities, to harmonize with an infinitely changeable environment, requires a selective power to pick out the appropriate pathways through the brain. Most of this guidance is done automatically by the environment. One combination of sensations would
guide the impulse into one direction, and another into some other. A mass of sensation opens up this channel and closes that one.

In the higher centers of the brain the guiding power rests, to a degree, with the consciousness. The attention, or center of consciousness, is continuously picking out the sensory stimuli for mental impulse, some from the memory and some directly from the environment. It determines the direction for this mental impulse, and consequently for the body's activity. The intensified selective power of firmly fixed attention, which amounts to interest or enthusiasm, affords the impetus to establish new mental pathways which the environment otherwise would not. Thus by its own effort the mind forms such association paths as will raise the person's value in the community. Interest is a basic factor in the mastery of a new problem; whatever be the subject matter studied, close attention is a requisite to material progress.

Memory and Habit.—The stability of a mental pathway depends on some inherent retentive faculties of the mind. Each mental impulse leaves behind its impress; evidence that it has passed remains in that today's thoughts are remembered tomorrow. The impression becomes firmer with successive repetitions. Some people require several passages of a thought in order to remember it as well as others would after a single passage. No amount of effort can enlarge the essential capacity for remembering. Ability to remember a certain type of subject matter increases by repeated thought along just that line, or by its association with passages already familiar; memory does not thereby improve for dissociated subjects.

The repetition of a thought or action is easier than was the original. The first mental passage not only leaves its mnemonic imprint, but it establishes a line of less resistance for subsequent ones. This is the basis of habit. Anything becomes easier to do and harder to avoid after each repetition. Every impulse, whether good or bad, leaves in the mind its influence.
Concentration.—The first passage of a mental impulse may require marked attention and interest. Succeeding repetitions call for less and less. When a path of least resistance has been formed the impulse goes its course unnoticed. A continued interest in the subject now selects and relates with that mental process some other associations. To master a study, we continue to focus on it such interest as to bring in more and more phases. This fixing of the attention into one channel, to the exclusion of unrelated ones, is concentration.

Habitual thought on the subject becomes easier, and richer in related associations. This channel in the mind is gradually enlarged to involve more brain cells, and a greater volume of thought is possible. Eventually one becomes an expert, and his mind carries a load of which the beginner was incapable. Concentration is the greatest voluntary factor in study. Interruptions, physical discomforts, or any other distractions which would transfer the thoughts, interfere.

Mental Deficiency.—Deficient minds are those which are hopelessly impeded, so far as some essential kinds of association are concerned. An apparently stupid child is much more commonly the victim of defective sight or other physical handicap, but in some an expert's examination would show the defect to be in the higher centers of the mind. The mental defectives have long been classified into the idiots, whose mentality is advanced only to the stage averaged by a baby and who therefore cannot even manage their immediate bodily needs, the imbeciles, whose development of mind proceeds to the young child's average, and the morons, who develop no farther than the twelve-year average. Recent workers list also the slightly subnormals, whose capacity surpasses somewhat that of the moron.

Even the least deficient of these are unable to adjust themselves well to the rest of the world, and have but feeble comprehension of community ideals. The community expects that each individual's pursuits, while benefiting himself most directly, shall be of service to the others as well. People without a healthy mental equipment cannot quite grasp this, and sink toward the narrower and more self-
centered standard of the underworld, that social order which is supported by crime, vice and pauperism.

**Training of Defectives.**—The usual denizens of the underworld are the uncared for mental defectives, and some with a mental capacity inherently better but not developed. They become social parasites, and derive from the community a support for which they give nothing in return. The drift to the underworld is abetted by poverty and other social handicaps.

Intelligent management of these people must discriminate according to the extent to which their condition results from inherent deficiency. While some can be reclaimed by change of environment and mental discipline, there are others who cannot be expected to lead responsible lives and whose existence needs supervision. Half-witted paupers or prostitutes are not capable of a choice between the unsanitary establishments in which they live and any other. It is the province of the mentally competent of the community to see that they are transferred to a more hygienic mode of life.

The training of defective minds is limited to those association paths which are normal and capable of development. Instances are commonly cited of persons who are totally unable to take care of themselves, but who under supervision become musicians of considerable worth. The child with a defect in its mental make-up gains much more from classes specially adapted to its needs than from the grades. Minds unsuited for academic training sometimes progress well in some sort of vocational work. It will some day be practicable to pick out all the defectives during their school age, and by properly supervising them to reduce greatly crime and pauperism.

**Impediments in the Normal Mind.**—Minds not crippled by a total incapacity in any direction are nevertheless better equipped for some things than for others. Some families produce many scientists, while other equally intellectual families produce none. The extraordinary interest and capacity of a precocious child for one sort of work tends sometimes to divert the child to a hurtful degree from other mental and physical activity; the special talent should be
moderately encouraged though not given exclusive rights over the mind.

Broadening of any association path can proceed only according to the inherited capacity of that path. The amount of interest spontaneously attracted by a type of association indicates such capacity; on this depends the adaptation to occupations of natural preference. Psychological tests also indicate the developmental capacities along a given line, and when more fully developed will make ideal entrance examinations for professional schools. The inherent structure of any mind is such that impulses through some of its channels run freely, while those through others are naturally depressed.

**Psychoses.**—Influences other than hereditary make-up can also in one way or another depress or animate mental activity, some only transiently and others more essentially. The most pronounced and serious of these are the various *psychoses*. Psychoses are definite diseases of the mind; an attack by any of several agents gives rise to them. To a degree they correspond with the insanities, but the two terms are not interchangeable. Insanity is a legal term indicating that the relationship with the rest of the community is not a sane one, within the meaning of the law. Psychosis is a medical term for specific disease of the mind; it often manifests itself as an insanity. Psychoses result from both hereditary and external agencies. Parasitic infection is one frequent cause, and injury to the head another. Preventable psychoses are often secondary to diseases which have first involved other functions; prophylactic measures are taken up in the other connections.

**Mentally Active Drugs.**—Mental activity is variously stimulated or depressed by the action of certain drugs. Under stimulant influence the mind increases in efficiency, and the quality and amount of work done improves. Under depressant influence it loses in efficiency, resulting in less and poorer work. Nicotine, caffeine and alcohol have come into wide use, through their effect on the mind; except in the case of the last, their influence is temporary and they have affected but little the health of average users.
Athletes, especially while in training, do better without alcohol or any other of the drugs mentioned. Most authorities are agreed that children develop better without them; periods of artificial stimulation or depression could well alter the growth of the mind. There is no evidence that the almost universal tea drinking among Chinese children hurts them, but comparisons are hardly justified; the oriental mind is different from ours, and the tea made there is weak.

**Caffeine.**—The use of tea or coffee is almost world-wide. Many peoples have found them desirable, though in excess they have proved to be undoubtedly bad. There are persons who cannot sleep or are otherwise disturbed after taking very moderate amounts. The view, prevalent in some quarters, that seemingly well-tolerated quantities do injury would appear extreme. The caffeine, which gives these drinks their stimulating effect, improves for a while the mental activity. One does more and better work, and sensations of fatigue are diminished. If tire should develop but not be felt as fatigue, the likelihood of overworking and perhaps straining the mind would increase; such a claim has been made in the case against coffee. This would suggest that those subject to insomnia or other symptoms of mental strain ought to be cautious.

Coffee and tea contain tannin as well as caffeine; this has no mental activity, but to some persons is constipating. The flavor and aroma of coffee is due to the harmless volatile oil, caffeol.

**Nicotine.**—Nicotine is considered depressing to the mental faculties, but as emotions are soothed there might be relief from worry or annoyance and therefore improved reasoning capacity. In very moderate dosage it seems to do no harm. Mental effect of the nicotine varies with the amount consumed; if the same degree of influence is to be felt as time goes on, the amount must usually be increased. Cigarettes and dry cigars supply the smallest dosage of nicotine per given weight of tobacco, as the rapid combustion partly oxidizes the drug. Moist cigars burn less rapidly, and more nicotine is sucked in from the heated area next the fire.

Poisonous substances other than nicotine are also present
in tobacco, but the small quantity taken in by the smoker is not ordinarily harmful to him. Effects of smoking on organs other than the nervous system are thought to include a hardening of the bloodvessels, but the evidence for this is hardly conclusive. Users of tobacco with syphilis sometimes appear to have a particularly low resistance to cancer of the mouth, if a broken tooth should keep the membrane raw.

Alcohol.—Alcohol also depresses. In this case the orderly reasoning processes are interfered with, as is noticeable from the beginning of the influence. For a time an emotional activity supplants the lost reasoning power; one urge to alcoholism is the enjoyment included among the emotions stirred up. The emotional stage has been called one of stimulation, but the mental capacity is depressed during this stage and throughout. As the alcoholic effect increases, the depression deepens and sleep comes on.

The conspicuous harm which alcoholism does to a person is the reduction in his mental capacity while wholly or partly under the influence. There are also more lasting effects, though these have often been exaggerated; they prove greater or less according to individual resistance. Desire for alcohol tends in all cases to increase, and in those of a certain inherent make-up it readily passes beyond control. The mental inferiority exhibited by some drunkards when entirely off of drink is not altogether the result but largely the cause of the drunkenness.

Such inherited traits as lead one to alcoholism are quite independent of the use of alcoholic drinks by his forebears. Alcoholism of the parents does, however, have a congenital effect other than hereditary; this might conceivably impose some desire for alcoholics. The baby's constitution is in various respects weakened by prolonged alcoholic excesses of the parents before its birth.

Psychoses (delirium tremens, et al.) sometimes result from the long use of alcoholic drinks. Injurious effects occur also to the liver (alcoholic cirrhosis), the stomach (alcoholic gastritis), and other organs. The resistance to various diseases, notably pneumonia and sunstroke, is materially lowered by continued alcoholism. Alcoholic beverages not made by
experienced and responsible manufacturers, particularly the distilled liquors, develop compounds which are much more poisonous than the alcohol; the effects of "moonshine" poisoning are due largely to these other compounds.

**Mental Tire.**—Mental sluggishness comes also from sources other than hereditary traits, diseases of mind, and drugs. Excessive warmth of the room, or the ingestion of a heavy meal, impedes the activity of the mind by a reduction of the brain’s blood supply. Nutritional disorder or physical ailment of any sort also impedes mental activity, as does physical or mental tire. Mental tire can often be explained as the depression to nervous elements effected by an action of waste products from any working tissue. The nerve cells feel a tiring effect of their own activity as well.

An average of about forty-five minutes of concentration on an unfamiliar but fairly interesting subject begins to tire the adult’s mind. Children tire sooner, a young child in about fifteen minutes. On a very familiar subject, for which the thought channel is well developed, one concentrates much longer without fatigue. In this case, the involvement of a larger number of associated nerve cells means less load per cell; any one cell functions less continuously. An expert might never show tire from working on his own specialty. Functioning causes nerve cells to shrink in size and obliterates the microscopical appearance of some well-staining granules (Nissl bodies), which are not to be found in a tired cell but reappear after rest.

**Retarding Emotion.**—Association paths which are too greatly weighed down by the various depressing influences cannot do their work. An indication that they are too depressed for the activity being demanded of them is an accompaniment of unpleasant emotion. The backward student who strains over studies that he cannot master becomes irritable and disagreeable, but if the study is transferred to subjects of greater appeal he drifts back into a pleasant companionship with others. Physical defects which react on and weary the mind lead similarly to an irritable or worrisome disposition, as does mental tire from any cause. Nightmares and fear of the dark assail the child most when it is tired.
Repeated recurrence of fear, jealously, prejudice or anger is a sign of disorder, physical or mental, which needs diagnosis and would often profit by treatment.

Such emotions are themselves a depressing influence; they not only indicate but serve to increase a mental handicap. Nothing fatigues the mind more quickly than this sort of emotions. They also interfere with mental growth by crowding out constructive emotion. Sentiments into which retarding emotions are established with the reasoning processes exclude others which incorporate desirable emotions; a harmful anxiety excludes the really serviceable hope.

Constructive Emotion.—The constructive and healthy emotions are such mild and not unpleasant ones as enthusiasm, confidence, determination, and happiness. Not only does an enthusiasm for something carry the mind into an understanding of it, but this enthusiasm is responded to from the minds of other persons and leads into wider social relationships. The generous and optimistic person is the person with many friends, and this companionship broadens his view to include other than selfish standpoints. A mental breadth and an improved position with the rest of the world develops.

Children receive much of their training from playmates and ought to be strongly discouraged from living to themselves. The pleasant and broadening emotions of companionship should come early into sway. Companions are preferably of the child's age, and disciplined, for by setting fashions they might make either good or bad impulses seem desirable, but only the really demoralizing companion could be worse than none.

A timid reserve might easily be overcome in early childhood, before it is a fixed habit. Otherwise it leads more and more toward seclusion, and thereby develops into a worse emotional reaction. In place of such friendly admiration of others as to widen social connections, there comes a jealousy which tends instead to narrow them. Great mental breadth is attained only with constructive emotion.

Emotional Excess.—Violent emotion of any type is a hindrance. It upsets the mind's trained control over the body.
For that matter, it upsets involuntary impulses in control of the body as well; with fright, anger or grief, the skin blanches, tears come, and digestion is interfered with. The orderly mental functions may be entirely supplanted by strong emotion; bad judgment and unsound reasoning are almost to be expected at times of great anger or hysterical joy. The figurative conception that an emotion’s attendant impulse can sweep open new thought channels in the brain leads to another, that if too excessive such impulse might tear through some short cut to a resultant bodily activity. Violent emotion is a poor guide. Another bad effect is that, like the undesirable type of emotion, it engenders fatigue. Orderly conscious activity is not nearly so tiring.

Emotional Discipline.—The training of emotion consists in its subordination to the more orderly mental processes, and in the crowding out of its disagreeable forms. The ease with which emotional excess can be controlled depends on how well the mind has accommodated itself to the environment. An emotion’s intensity is proportional to the novelty and uncertainty in the situation faced. A mental process which had been trained to direct the conduct in such situations would be less subject to emotion. A hold-up does not frighten the plain-clothes policeman, who knows intuitively what to do if held up; but most persons, whose intuition says all at once to give in, to fight, and to run, get scared.

A sustained sentiment—pride for instance—which frequently calls forth an emotion is likely to represent a relationship which remains very uncertain. The pugilistic champion retains a pride in his ability to overcome contenders but he is not proud of his ability to overcome cripples; the first relationship is not a settled one and the second is. The same obtains with the opposite type of sentiment. Thorough mental training of any sort adjusts one to the environment and tends to eliminate uncertainties; this lessens the effort necessary to control emotionalism.

Habitual fear or anger harms particularly the mind during childhood. At this time above all others the influence of mildly pleasant emotions is needed. The worst feature of severe punishment is the frightened anticipation of it. The
apparent need for punishment arises to a great extent from weakness and carelessness in the child’s previous training. Continual emphasis on what is right with such correction as to enforce it regularly makes severe punishment unnecessary. The anticipation begins after the offense anyway, and leads to deception more often than to good behavior. Anger as well as fear might tend to dominate the child’s mind if allowed to become habitual. With spoiled children this occurs; if their playmates are contrary they yell for mother, and if they want too much candy they have a temper fit. Uniform futility of such outbursts would disillusion them and lead to a better mental reaction.

Aids to Mental Impulse.—Productive mental concentration follows a mild and constructive emotion, and whatever depressant influences would upset this state of mind retard it. The attention must steer away from anything that would arouse violent emotion or bad types of emotion. If too great warmth of the room is felt as a dampening of the enthusiasm, the room is cooled until the failing interest revives. Physical disorders which depress the activity of the mind should have been corrected when first noticed. When the mind tires itself out, the interest and progress decline until after a rest.

The rest for a tired mind comes with a shifting of the load of work from the tired nerve cells. Change of the subject worked on shifts the load partially; some of the same association cells and some others are then employed. Mental recreation, in the form perhaps of a visit to the “movies”, gives greater exchange of the cells at work and correspondingly greater rest. Recreation by outdoor games or other physical exercise transfers the work still more and is more resting. Sleep takes off more of the load than anything else we can do.

Sleep.—Adults usually need a night’s sleep of from eight to ten hours; many retain a clear mind throughout the day with a good deal less. Their preferences in the matter can hardly be criticized unless effects of tire appear. Children, on the other hand, should be assured plenty of sleep regardless of how they feel about it. Sleep is most essential during the early development of the brain. A baby at first sleeps all but a few of the twenty-four hours; this period should
not decrease too fast. The child should have about eighteen hours at a half year, fifteen at one year, and twelve at four years of age. The period is then shortened by a quarter of an hour each year through childhood. It is an unwise desire of many children that sends them to bed too late for this amount of sleep. Hours for bedtime and rising are best set arbitrarily; for young children, part of the sleeping period is best made an afternoon nap.

Sleep comes when the diversity of sensations received is so cut down that consciousness is not needed to guide their impulse through the brain. People lie down in a dark, quiet room to avoid environmental stimuli, and perhaps count sheep to narrow down those stimuli which spring from the memory. Other factors behind sleep and sleeplessness crop up, which are confusing. Sleep is not yet understood.

**Insomnia.**—Insomnia often means an overtiring of the mind or of the eyes. Physical defects or disorders aggravate the tendency. Heavy meals in the evening, or too much coffee, often predispose. A common formula for inducing sleep, in addition to the avoidance of these things, is as follows: The troubled person takes a half hour’s recreation, preferably outdoors, just before bedtime; then, without any more reading or mental work, he takes a warm bath and goes to bed. The bedroom is in the meantime cooled off to the lowest temperature compatible with comfortable sleep. Another most important item is that bedtime be regularly at the same hour.

**Symptoms of Tire.**—It is often difficult to distinguish clearly between tire of the mind itself and tire of the eyes. If the eyes have been found normal or properly fitted there is little reason for making the distinction, for as a rule the mind and eyes must work together or be rested together. There is no sign for absolute localization of tire to the mind, unless it be greater difficulty in mental concentration on one problem than on another equally familiar one which taxes equally the same senses.

The first suggestion of tire is a diminution of interest and disposition of the mind to wander. The progress of the work done soon declines in speed and accuracy, unless the mental
effort be forcibly increased. Later come unpleasant emotions of dislike and irritability, and then the progress slows down quite sharply. Perhaps an insomnia results, or headache. These symptoms accompany the growing tire from mental work.

Toleration of Tire.—The extent to which the mind can tolerate fatigue without suffering from it varies with individuals. The limit in most children is low. Mental work in early childhood should not be carried beyond the point of spontaneous interest. That safe for the baby is even less; the baby laughs and kicks when shown attention and may continue to do so until it is quite tired. The practice of entertaining a baby until it tires and cries, and then of bouncing it about to cheer it up, strains the little mind that so greatly needs rest instead.

Mental activity in the adult, or even the older child, need not necessarily be limited by the symptoms which suggest beginning tire. An abatement of interest and enthusiasm is hardly a danger sign, for good work is done by minds tired beyond this point. Good work is done on problems which were not interesting from the beginning; the mind channel of high capacity yields enthusiasm when called on, but that of lesser capacity may also get results.

Mental Strain.—Insufficiency of a mind channel's capacity, from any of the several causes, may result in such overloading as to strain it. The faculty may have been neglected or have proved incapable of development, or it may be worn down by emotion, tire, sickness, alcoholism, or other influences. It is then unable to make the environmental adjustments demanded of it, and is strained by the attempt. Mental strains are due less to great volumes of work by the mind which is in condition than to ordinary work by the mind which at the time is unsuited for it.

The earliest symptoms of mental strain are those of continued tire. An occupation slowly reduces the ability to concentrate, and changes the emotional reaction. Instead of confidence and enthusiasm in planning the work's progress, there is anxiety about its outcome. There also appears a tendency to insomnia and to irritability, and sometimes to
headache or dyspeptic symptoms. When these symptoms are aggravated and accompanied by uncontrollable emotion and even perceptual disturbances, the condition becomes that widely referred to as nervous prostration or breakdown. Nervous breakdowns have resulted from physical ailment, and from doggedly following distasteful occupations or those with uncertainties entailing much anxiety.

Such strain may simulate the hereditary condition of self-centered incompetency spoken of as a form of neurasthenia. The employed thought channels in persons with this disease are inherently subject to tire. The mind may in some cases be as well suited to housework, for instance, as was that of fortunate ancestors with this to do, but for the life which the patient wants to lead the channels simply are not adequate. The symptoms are a continuous sensation of fatigue, inability to work without tire, and limited capacity for efficient mental activity; also there is insomnia, worry, and excessive emotionalism. Persons who naturally are not such misfits in the environment, and whose minds are suited to their walk in life, can be fatigued by anxiety or physical disease into a condition which appears for a time quite similar.

Management of Strain.—Relief from severe mental strain requires at the start complete rest. Any cause for fear or worry, or any contributory physical ailment, is to be removed. After an interval of quiet resting come regular periods of concentration, which at first are short but gradually increase until normal study is possible. As interest attaches to the healthiest of the thought channels, the subjects for study are selected according to the interest displayed. Periods of concentration are limited to the duration of the interest. The obstacle that comes up before unfortunate neurasthenics is that nothing is discoverable within their sphere of life which really interests them.

Spoiled Children.—An analogous condition of strain is found in the undisciplined child. This condition may result from careless training or from inherited incapacity for mental discipline—though the latter is very rare. According to the intensity of the symptoms, the child is referred to as spoiled,
as strong-willed, or as nervous. Essentially selfish, ignoring any rights of others, fatigued even on rising, sleeping neither readily nor soundly, given to superficial sorrow, anger and fear, and to giggling, crying and temper fits, the pronounced case simulates in miniature the neurasthenic. Adjustment to the surroundings is difficult for it.

Strain of the young mind is often through insufficiency of sleep, resulting because the child is permitted to stay up too late. It is often due to physical defects, or to some undiscovered and mild illness. It may also result entirely from the mental confusion incident to careless discipline and from a non-comprehension by the child of its proper relationship with others. Spoiled children rapidly improve when their relationship with others is made clear to them, that is actually clear, and when other causative factors are controlled. If not put right at home as to their relative importance in the world, they usually are by their companions, sometimes with a vengeance, later. The only hopeless cases are the few with inherited incapacity for discipline; these pass on into a self-centered adulthood, often with the neurasthenic characteristics just described.

Mind in Childhood.—The earliest step in the child's mental development is a collection of sensations, from which can be built later the complex association processes. Variation in childish experiences affords the opportunity for sensations, if the sense receiving organs function well. During early childhood a confined life, or one without companionship, is likely to prove a greater handicap than are defects of the receptive organs. The sense of touch is never impaired, and through it the little child does most of its sensing; the eyes are rarely impaired enough to interfere with the visual demands of that age.

On seeing a toy the child must feel it; then he begins to know it. View of another toy suggests something different, and he proceeds to handle that one. The frying pan and the stove blacking offer something still different, and invite the child's study. The fire remains fascinating, until he has been burned. This groundwork of sensation affords material for the first simple associations.
Early Training.—Prior to school age, the natural inquisitiveness is sufficient urge to learning. With very little encouragement the child proceeds to store in and associate simply together the sensations. The child is not prepared always to select well in its search for new experiences, and needs the judgment of an elder who better understands and is ready to pass very certainly on its problems. Limitation to the childish investigations are to be made unwaveringly if at all, though the fewer such limitations the better. Too great repression changes the emotional reaction from a happy to an unhappy one, which is a hindrance to mental growth.

Another essential to the young child’s training is a clearing away of the confusion which so easily creeps into the unskilled attempts at association. A huge and disordered mass of impressions is taken in for registration in the memory, and these impressions are to be put into a simple relationship. Parents aid the child to do this by answering such questions as are impelled by the awakening curiosity. Patience and quiet pleasantness of the mother stimulates mental health in the child, and she serves the child better by thinking of her own comfort and rest than by working for it to the point of fatigue and exasperation.

Discipline.—The child cannot yet be made to understand some conditions which it encounters, but it can be made to see more clearly what these conditions are. The necessity for yielding to authority and the distinction between suggestion and command are not grasped unless taught. A little boy told to lie down but not made to lie down is impressed about as he would be by a suggestion that he play with his teddy bear. Orders which may or may not call for obedience are cruelly confusing.

Property ownership is just as unintelligible until taught. Children who get everything they want are given the impression that everything is theirs on demand, though some things perhaps must be screamed for louder than others. This does not occur with the child who, on asking for a thing, is always told truthfully at the outset whether or not he can have it.
Training at School Age.—The training of the somewhat older mind, which is entrusted to the teacher, requires but supplementary attention in the home. Moral training and discipline comes best from the parents. Parents who deprive their children of discipline in the hope of encouraging originality and initiative make them careless of others and mentally unstable, but they do not make them any less imitative. Such children imitate their companions, probably the worst of them, and continue to do so until late in childhood, when they reach the usual age for true initiative to appear.

The home may also be expected to put the child into condition physically to get the most out of its school work. The most handicapped among school children are those whose eyes are quickly tired through defect, who cannot hear all that is being told, or who cannot become interested because they are tired, improperly nourished or otherwise uncomfortable. That physical ills retard mental development is amply demonstrable. Physical defects are always distributed most prolifically among the poor students and least so among the good ones; their correction puts backward children within a year or so among those of higher scholarship. For correction of such defects, the school must have the cooperation of the home.

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CHAPTER XI.

PHYSICAL EXERCISE.

Physical exercise has four prominent purposes. It develops the nerve-muscle mechanism; normal growth or the correction of any defect of this mechanism requires exercise. It maintains indirectly the health of the other functions of the body. It aids mental development. Finally, it is a most effective form of recreation.

Exercise taxes many of the body's functions and if not excessive strengthens them all through an increase of their resistance to such strain. Most organs tend to develop when used and when not used to waste away, or atrophy. The condition of the weakest organ involved gives the index of how much exercise is safe, for the strain that exceeds any function's resistance does definite harm.

Muscles.—About half of the body, by weight, is muscle tissue. There are three kinds of muscle. That for the voluntary movements of the body consists of long spindle shaped fibers, each striped crosswise and containing indistinct nuclei. Conscious processes of mind control the nerve impulses to these muscles. Another type, which is not striped and is independent of voluntary control, is called smooth or involuntary muscle. The muscular coat of the intestine is an instance. The third or cardiac type, which consists of short, broad fibers, makes up the muscle of the heart.

Muscular Growth.—Muscular action, whether voluntary or involuntary, must be brought about by nervous impulse. In response to the impulse, a contraction of the fiber pulls in on the attachments at either end. The necessary energy is derived from the consumption of fuel foods, and as the activity tends to wear out the muscle, protein food also is required to keep it in repair. The tissue formed in repair exceeds in
amount that destroyed by the activity, so the muscle becomes larger. The fibers increase in size and number.

The volume of muscle tissue increases most through very heavy work, which tears down the muscle greatly and calls for correspondingly great repair during the rest which follows. This is not necessarily of advantage, for voluminous muscle tissue is of real service to but few; it handicaps others by adding to the load on the heart. Pneumonia seems sometimes to strike big and husky men hardest, presumably because of an inability of the heart, overworked already for the supply of so much muscle tissue, to take on the additional strain caused by the disease.

The older gymnastics which aimed to enlarge the muscles, particularly of shoulders and arms, is losing in popularity among physical directors. In ordinary pursuits these muscles do not need to be powerful, and the piling on of needless muscle tissue is bad. Such exercises instead as develop the trunk muscles are receiving more attention than formerly.

**Nerve Control.**—Development of the neuro-muscular system is something more than the building of muscle tissue. Of greater importance is the building of a nervous driving force to operate the muscles. The first attempt to paddle a canoe or play tennis is clumsy and fruitless, though superfluous muscular energy is expended on it. The nerve impulses are neither timed right nor sent entirely to the right muscles. Training coördinates the motions and eliminates superfluous ones, and thereby builds effectiveness.

The nerve control which leads to this proficiency comes better by many repetitions than by spasmodic, strenuous exertion. The weight lifter has more conspicuous muscles than the wrestler, but is less capable of continued work because of his poorer nerve control of them. Such control develops from a long and consistent course of moderate exercises, each begun in a rested condition, and does not develop from an occasional overstraining. It is the continuance of regular exercises over a long period of time that can be counted on to impart strength and skill.

**Exercise of the Baby.**—The baby's exercises bring about nervous control just as they do a development of muscle
tissue, a fact lost sight of by many who insist on trying to help the baby gain strength. The formation of nervous correlations proceeds after a perfectly ordered plan, each accomplishment paving the way for the next. The baby first uses simple arm and leg movements, later grasps things, and still later rolls. After from about six to nine months it sits up, and within the year begins to walk. Any attempts by adults to hurry along one or another of the baby’s activities tend only to upset the plan.

The baby should be allowed to follow its natural inclination. A backwardness is not through want of instruction, and it may be a preventive of deformity in unrecognized rickets. The following of the natural inclination should not be hampered by confining clothing, nor during late babyhood by too much penning up in bed. Much outdoor play is to be encouraged.

Corrective Exercise.—Corrective exercises are those designed to build up some specific neuro-muscular coördination. If certain muscles have failed to develop as they should, it may be possible to correct the defect through certain exercises. Functional defects of posture are managed through corrective exercises. Or again, some of the muscles may need extraordinary development to compensate for the loss of function by others. If a thumb has been destroyed, the remaining muscles of the hand need added development in order to function without it. The tedious corrective exercises and other aftertreatment of infantile paralysis have for their aim the equipment of the muscles which are left to compensate for those left powerless by the disease.

Posture.—The posture of the body depends largely on the relative strength of different groups of muscles. Posture is the position in which the muscles hold the body, a more or less upright position in the case of human beings. One great advantage of the erect position is the freedom allowed the upper extremities. If part of the musculature can strengthen sufficiently to hold the body in position, the rest is left free for other work. The posture which calls only on the necessary muscles has the chest somewhat forward and the head and hips somewhat back; a slouching posture hangs part of
the weight on other muscles as well. Assumption of a good posture is best attained by the forced attempt to raise the top of the head as high as possible, without raising the heels.

*Gauge of Posture.*—The posture may be gauged simply and well by the apparent axes of the body. The true axes should pass vertically for the head and neck, downward and forward for the back, downward and backward for the pelvis, and downward and slightly forward for the legs. The combined or apparent axes are vertical for the trunk as well as for the head and neck. On side view an imaginary vertical line dropped from in front of the ear to slightly in front of the middle of the foot should parallel the apparent axis of the head and neck, and also that of the trunk of the body, and it should pass just in front of the tip of the shoulder (*Bancroft's test*). Viewed from in front, the body should appear symmetrical.

![Fig. 18. — Temporary splint.](image)

**Fractures and Dislocations.**—Deviations from this postural standard are by defects of skeleton or of muscle. Acute postural injury includes fractures, dislocations or sprains. Dislocation of the finger can often be reduced by pulling straight out on the finger. Fractures, or dislocations of joints other than of the fingers, are better given first aid and left for the care of the surgeon. The greatest possible rest is afforded the part, and pain relieved through methods already gone into. An injured tissue is rested if the member is propped into a position by sandbags or other supports, or if it is bandaged firmly to a support of some sort.
A badly injured leg may be put at rest in a roller splint. The latter is made by spreading out on the floor a suitable sized piece of fabric, and rolling in the two ends about boards until the rolls come almost together. Turned over, this affair can be placed under and fastened about the injured leg and gives firm support. The contrivance was made originally with a blanket on the battlefield, and was called the blanket splint.

**Prevention of Deformity.**—The prevention of joint and bone deformity is by proper treatment not only of local injury but also of some general diseases. Spinal tuberculosis requires prolonged rest of the spine in a straight position, if humpback is to be avoided. Rickets causes several bony deformities, and the legs may be badly bowed or otherwise disfigured if the weight of the body is put on them while the disease is active. Many of the babies who are backward about sitting up and walking prove to be retarded by rickets; by urging them to walk one would induce deformity. Avoidance of subsequent deformity is a consideration in the treatment of several diseases.

**Spinal Curvature.**—Functional defects of posture are those due to low tone of the muscles. Assumption of the upright position by man throws greater strain on the musculature of the back than does the horizontal position of other animals. If the strained muscles yield, postural defect results. Weakness in the muscles of the lower back, or lumbar region, leads the child in school to support the upper as well as the lower part of the body, and so he slides down in his seat or slumps forward on his desk. The use of badly fitting school desks aggravates the curvatures, and an important item of school hygiene consists in adjusting the height and shape of desks to the occupants.

Curvature of the spine is positively counteracted only by the building up of the musculature. Prevention or correction of curvatures is by such exercise, rest, and nutrition, as will build strong back muscles. Such gymnastics as somersaults or lifting exercises when in a standing position develop these muscles. Ordinary outdoor play is perhaps the greatest preventive of curvature. Girls average a weaker muscula-
ture and more spinal curvature than boys; they need outdoor play just as much.

Varieties of Curvature.—General fatigue of the body relaxes the tone of its postural muscles. The head and shoulders droop forward and the chest sinks back. Tuberculosis and other debilitating conditions which induce fatigue are characterized by this posture. Its habitual assumption predisposes to a permanent spinal curvature with backward convexity (*kyphosis*). The curvature is accompanied by a forward inclination of the head and neck axis, by an apparent flatness of the chest, and by a rounding of the shoulders. A sitting posture which rests the hips on the front edge and the shoulders on the back of a chair or bench promotes the same deformity.

A spinal curvature of forward convexity (*lordosis*) is said to result sometimes from attempted overcorrection of the tendency to backward curvature. Very fat persons normally assume this forward curvature to bring their excessive weight back over the center of gravity. Lateral curvature (*scoliosis*) results from a muscular weakness more pronounced on one side than on the other. It is promoted by habitually resting the upper part of the body on one arm or one shoulder. Carrying books under one arm curves the spine laterally, and might also promote the deformity if the load is carried always on the same side; if the sides are alternated, the effect on posture would be good. Occupational curvatures, such as that which sometimes develops in postmen to support a load on one side, might equip better for the work to be done than a symmetrical posture.

Posture of the Foot.—The posture of the foot is altered more or less by most of the accepted footwear of civilized peoples. The best shoe, from a postural point of view, is one of which the inner margin follows a straight line from beside the heel to beside the great toe, which is broad across the toes, and has a flexible sole and a low heel. A shoe of this shape permits the foot to function naturally, and should be insisted on for the developing foot of childhood; older people can often choose footwear from other considerations and suffer no harm thereby. The high heeled shoe alters also the general
posture; many women are impressed quite favorably with the alteration. It increases the height, throws the hips slightly forward, and lessens the body’s freedom of movement.

**Weak Arches.**—The shoe which presses in on the great toe forces the axis of the foot outward beyond the body’s center of gravity, and by throwing the weight toward the inner margin of the foot presses down on the longitudinal arch. Walking with the toes out has a similar effect. Toeing in brings the axis beneath the center of gravity and permits firmer support; this operates against the falling of the arch. Lowering of the arch, or flat-foot, may or may not be associated with local discomfort.

The strain spoken of as an acute breaking of the arch is indicated by a rather sharp soreness along the inner margin of the foot, which makes walking painful. It is not actually a giving way of the fascia of the arch at all, but is due rather to a weakness of muscles with consequent rolling in of the foot, lowering of the arch, and local congestion with swelling. Toeing in relieves the pain somewhat. Temporary relief is gained by an adhesive tape support. The arch is forced down into an eighteen- or twenty-inch strip of the adhesive tape as into a stirrup, and the two ends are then pulled, crossed over the ankle, and stuck to either side; several such strips are applied. Strain of the transverse arch, suggested by a similar pain in the fore part of the sole of the foot, is eased by an adhesive tape bandage wrapped firmly about this part of the foot. Supports of various types with which shoes are fitted also take off the strain. Supports for the foot are but emergency measures, and their continued use is not desirable except for incurably weak feet.

Development of the foot is hampered by arch-supporting shoes. The play of the muscles is interfered with and as strength of the foot is unnecessary it does not develop. Walking or running in soft soled gymnasium shoes, or barefoot, affords strengthening exercise to the muscles holding up the arch. A more specific foot and arch exercise consists in standing on the edge of a chair with the front part of the feet protruding, and alternately contracting and relaxing the muscles of the soles. Another is the repeated raising and
lowering alternately of the heels or of the toes while standing. Almost any regularly continued exercise of the foot strengthens the arch; it is the exertion following relative inactivity that is likely to strain.

**Exercise and Health.**—The activity of organs other than nerves and muscles depends just as much, though less directly on physical exercise. The circulatory system must speed up for the supply of more oxygen to the working muscle, and by doing so it calls into greater activity some other parts. Many organs tend to become sluggish in a life routine from which active exercise is excluded. The laborer's health is preserved by his day's work, but the office man's sometimes is not. While some who lead sedentary lives retain the health necessary for their mode of life, there are others who acquire a tendency to obesity, to constipation or to headache, unless they take additional exercise.

**Circulation of the Blood.**—Next to that of the skeletal neuro-muscular system, the circulatory function is the one most directly affected by physical exercise. Oxygenated blood passes from the lungs to the cavities of the left part of the heart, the muscle of which repeatedly contracts and pumps it along in a direction maintained by the heart valves. This force from the heart carries the stream through tissues, food-supplying organs, and eliminating organs, and back to the cavities of the right part of the heart. The oxygen is meantime taken out for energy production, and the right heart forces the stream to the lungs for more. The blood must flow faster to satisfy a demand from working tissues for an increased oxygen feed.

Metabolic waste products stimulate to added work the muscles of the heart and bloodvessels. The heart beats faster and the blood-pressure rises. The readiness of this reaction is one of the practical indices of circulatory efficiency. If a healthy person hop some 40 feet, the pulse-rate increases on the average about 5 beats per quarter of a minute, and if he then stand still it returns within a minute or so to the original rate. The heart which is in good condition from regular exercise might return to normal in a half-minute or less, while in one more sluggish the reaction is delayed.
In general, the vascular change brought about by exercise transfers blood from visceral vessels to the vessels of the skeletal muscles, and in the latter it accelerates the flow. To provide for such an increase of blood supply to the working muscles the local vessels dilate, due also to an effect of the waste products.

"Charley Horse."—Very strenuous exertion of a muscle, especially in those unaccustomed to it, is sometimes brought to an abrupt halt by a sharply acute and incapacitating pain and stiffness in the muscle. The pain often follows a blow to the strained muscle. Spasms incident to the readjustments within the muscle have caused blood to congest in the muscle’s vessels; these bloodvessels are sometimes torn and there is bleeding into the tissue. The part is better rested at first than manipulated; too active manipulation
could make matters worse. An application of heat, by hot-water bags or wet dressings, and subsequently careful massage, aids recovery. The massage should be light and superficial until the muscle has entirely relaxed.

Muscular Fatigue.—Another local discomfort results from an accumulation of carbon dioxide and other waste, which depresses the tissue. It produces a sense of fatigue, and even of aching and stiffness in the muscle. This discomfort is relieved by rest, an application of heat, and massage. The massage most useful for this purpose is in a direction toward the heart, and consists in a deep, kneading manipulation of the muscle tissue. Such manipulation aids the venous and lymphatic circulation to dispose of the accumulation. The lymph carries off much of the tissue waste which follows a hard workout. The flow of lymph is due almost entirely to pressure against its vessels, and is promoted not only by massage but by the exercise itself.

Varicose Veins.—The blood in the veins has a low pressure and a slow current, as its flow has been greatly reduced by the small caliber of the capillaries which carry it through the tissues. The muscles of the venous walls are weak, and the flow in them depends somewhat on the repeated pressure of the body movements, though to much less degree than does that in the lymph vessels; valves occur at intervals, permitting a current in only the one direction. The pressure of chest movements could help pump the heart, but the latter has such a powerful muscle that it does not need this help.

Among the maladaptments to the upright position which occur occasionally in human beings, is an abnormal weakness of the valves and walls of certain veins (varicose veins). These veins dilate from the pressure of their columns of blood. Such veins of the lower rectum (hemorrhoids: piles) are more troublesome when the bowel is constipated; persons who are troubled even mildly with them should be careful to avoid constipation. A simple and effective surgical operation corrects hemorrhoids, and another corrects varicose veins of the scrotum (varicocele). Varicose veins about the legs are not so readily overcome; the wearing of supporting bandages or elastic stockings is in most cases preferable to operation.
The use of circular garters might make worse such veins in the leg, and is to be avoided. The condition tends to get worse also if the person must stand for hours at a time. Elsewhere than in the three regions mentioned, varicose veins rarely become troublesome.

**Arteriosclerosis.**—The commonest obstacles to heavy exercise are the defects to which heart and arteries are subject. One of them is the hardening and loss of elasticity of the arterial walls (*arteriosclerosis*). As age advances beyond middle life, some fibrous tissue tends to develop among the cells of the arterial walls and of the heart; sometimes a good deal of calcium is also deposited. The arteries become more or less rigid. A high blood-pressure from nephritis or any other cause stretches the vessels and hastens the hardening. Excessive use of rich foods, alcohol, and tobacco, or continued mental strain, are thought by many physicians to hasten it. The condition tends to develop anyway as age advances.

The hardening of the vessels raises blood-pressure, and an additional rise due to exercise can easily rupture the hardened and non-elastic wall. If the artery which breaks is one about the brain, the hemorrhage is capable of severe damage by its pressure within the skull (*apoplexy*); partial unilateral paralysis results, and sometimes death. To be safe, the physical exercise of advancing age should be less and less strenuous. Games selected in youth ought to include some suited for continuance through life. Football and track work are suited only to the first half of life, and should be supplemented by other forms of recreation adapted to the second half. Golf need never be given up, so long as health continues, and is a much favored game from youth to old age.

**Defect of the Heart.**—Defect of the valves of the heart lowers the capacity for physical exercise. At every beat some of the blood is forced back through any valve that leaks, and as the tissues demand that a full supply still go forward the pumping done must provide for both. The muscle of such a heart gradually enlarges and strengthens until eventually it does easily the increased work demanded of it. Then the defect of the heart is said to be *compensated*.
PHYSICAL EXERCISE

The heart is using much of its natural reserve, however, and does not respond to excessive strains as well as would a normal heart. The person with a compensated defect should stop exercising at once whenever he begins to feel queer or short-winded. He should never enter an athletic contest from which he cannot conveniently drop out at any time. All exercises should preferably be under the direction of a physician.

If the strain becomes greater than the muscle can stand, the compensation breaks (decompensation). The symptoms of a non-compensated defect are swelling, usually about the feet, a bluish or dusky tinge to the lips or face, marked shortness of breath after comparatively little exertion, and tenderness in the liver region, about the lower ribs. Persons who experience any of these symptoms would do well to have their hearts examined, even though unaware of heart trouble. Swimming frequently overtaxes a defective heart capacity, especially if competitive or if the muscle has been strained already by previous exercise. Death from drowning in cramps is usually due to the failure of a defective heart. In some cases of valvular heart trouble the compensation does not readily establish itself, and the greatest of care must be long continued.

Nephritis.—Another function which puts limitations on exercise is that of the kidneys; nephritis, or inflammation of the kidneys, could be made much worse by strenuous exertion. Nephritis is suggested by swelling about the feet, and is definitely recognized by findings in the urine. Considerable danger lies in the high blood-pressure which accompanies chronic forms. Exercise would further increase this pressure. It would also add to the salts and other body waste, which already are being poorly eliminated due to hindrance by the disease.

In severe cases the physician keeps the patient at absolute rest, and devises all possible means to aid the elimination. The milder cases need not have as great care as this, but if neglected entirely have a marked tendency to pass into the more severe forms.
Elimination and Absorption.—Exercise does not affect absorptive or eliminative capacity in kidneys, lungs, or intestine, but all of these organs feel the effects in some way. The lungs respond immediately to exercise. The respiration becomes faster and deeper with the increase of muscular work, due to stimulation of the breathing center by the carbon dioxide produced. Increase of the amount of oxygen about the lungs is demanded. The deepening of respiration opens up the entire membrane to the air and tends to enlarge the chest expansion. Effects of this were discussed before. Pulmonary disease makes excessive exercise harmful because of strains thrown on the circulation and other functions rather than because the diseased lungs themselves are not equal to the emergency.

The aid of exercise to the digestive tract is principally an increase in peristalsis. Intestinal tone improves, and the abdominal pressure becomes firmer. Appetite increases, and any tendency to dyspeptic symptoms brought about by inactivity subsides. The value of exercise as a combater of constipation has been mentioned. On the other hand, exhausting exercise retards intestinal action; the much fatigued person makes a better meal after a short rest. Other connections between digestive activity and exercise were shown in an earlier chapter.

Heat Regulation.—The heat-regulating mechanism must increase the blood supply to the body surface to eliminate excesses of heat formed by muscular activity. The skin flushes and sweating becomes profuse. Sudden chilling at this time, by a cold plunge or otherwise, blanches the skin instead and tends to shock, though most normal people who try it are not adversely affected. Respiratory disease is sometimes thought to be induced, but this is rather doubtful; a few persons find that they have to be careful.

In the course of any fever exercise is bad, for the fever indicates a disorder of the heat regulating mechanism with reduced capacity to meet added demands. Rest in bed is called for, or at least a minimum of exertion. The febrile condition involves also an unnatural activity of the tissue
metabolism, to which exercise would only add. The policy of trying to work a fever out of the system by hard labor cannot be harmonized with physiologic needs.

The Mind.—Educational and recreative attainments were among the four purposes assigned to exercise early in this chapter. Both of these concern the mental workings, and but little need be added to what was said in the chapter on mental hygiene. Mental processes arise primarily from sensory impulses and lead eventually to motor activity. Study of such character as to keep the mind in the abstract and away from the body's activity is self-sufficient in trained persons, but for the average student it should be accompanied by other mental habits which connect more directly with an objective. Physical education balances the mind by developing also some mental qualities other than reasoning.

Alertness, self-confidence, etc., are bred by team play, for instance, much more than by what has been called a purely "word education." The mind with a tendency to introspection reaches for outside contacts instead. Team play is a widely acceptable form of mental discipline; a gang of toughs, unless mentally defective, welcomes the athletic training which makes it a team. This opens the way for a further educational advance at which they would at first have rebelled.

Recreation.—Recreative exercises have already been described as those games which transfer the mental workings from a tired association channel to a fresh one. Gardening might constitute a recreative exercise for office men, but not for the truck farmer. The recreative element might well dominate the indoor worker's choice of an exercise for his general health. Individual calisthenics, which hardly attract the mind from its routine, compare poorly with the more diverting recreation in which others also join. Other factors in his choice have been referred to; one will bear repetition.

Functions of the indoor worker react best to outdoor exercise. Recreational value of the indoors is less for him than that of the outdoors, for his surroundings are less completely changed. The muscles of the eye which have been
tired by near work are rested better by the long distance views of the open. The open air stimulates the heat regulating function more than would the most skillful ventilation of the house. Outdoor odors are more pleasant and add to the zest for the game. The outside light is more natural, and contains those rays which stimulate growth of tissue in much greater abundance; the vision also benefits from the more natural light. The comparison might be extended to other functions. The open air is too often thought of simply as an ideal source of oxygen for the lungs; this is the least of its advantages.

**Reading.**

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* See bibliography for titles and publishers of books.
CHAPTER XII.

THE HAZARDS OF CHILDHOOD.

The applied hygiene of one sphere in life differs from that of another in emphasizing a different group of health problems. A person prepares for approaching hazards more intelligently if he realizes which of the possible obstacles he is most likely to encounter. Preceding chapters emphasized most largely the problems of the student, and combined with systematic hygiene an applied hygiene of student life. The student will continue to meet the same array of hazards when his school days are ended, but he enters a few fields also in which others stand out.

Child Hygiene. — Children cannot look ahead and safeguard themselves, so child hygiene becomes a problem for the parent. Many of their ills and dangers are never recognized unless the parent knows what to look for. Danger signs are there, but they attract the guardian only if watchful, and the child not at all. Babies cannot express themselves, and older children tell only of sudden discomforts. They are not conscious of ills suffered from birth or gradually acquired, for without experience of the normal they accept any condition as natural.

The hazards are elusive, but cannot be neglected. Whether or not the little one is to remain in the world at all depends often on their control; early childhood suffers a far higher rate of preventable deaths than does any other age group. Besides, it is only during childhood that many of the maladies of later life can be anticipated by preventive measures. Much of the body's subsequent development suffers from a few uncorrected defects, the defect of one organ stunting the growth of another. Physical defects impede the mind as well as the body. Defects of the mind itself, while not subject
to prevention or correction, can have many of their consequences averted.

**Hazards of the Baby.**—Conspicuous destroyers in early babyhood are nutritional, gastro-intestinal, respiratory, and general infectious diseases. A few clear-cut warnings of their approach might be borne in mind. A rate of increase in weight which differs greatly from the average points to nutritional derangement; the birth weight should about double itself in six months and treble itself in something over a year, though on bottle-feeding the early gain is less rapid. The condition of the gastro-intestinal tract is indicated by the bowel discharges; looseness and excessive frequency of these, or for babies fed on cow’s milk a persistence in them of curds, suggests trouble. The common cold is a frequent forerunner of serious respiratory infections in infants. High fever with convulsions or vomiting commonly ushers in their general infectious diseases; slight fevers result from very mild disturbances and beyond calling for rest in bed are not necessarily significant.

**Summer Diarrhea.**—Intestinal disorder causes the high infant mortality rate of the summer months. Temporary and slight diarrheas are common in the summer and need give little concern. Teething is not responsible for them, even if they do occur with about the same frequency as the eruption of new teeth. It is the mild attack that develops into the severe summer complaint, however, and no diarrhea which continues for days is to be taken lightly. This dangerous type of diarrhea is traceable in part to bacterial contamination in the milk used for feedings, in part to the debilitating effect of the heat itself, and in part to the use of feedings rich in sugar or otherwise badly proportioned. The hygiene of babies in the summer should have emphasized the pasteurization of all milk of ordinary grades, the wearing of clothing light enough to let out body heat, and the proper proportioning of feedings. Overheating of the body is a real danger; chilling is one in the fall but not in midsummer.

**Infectious Diseases.**—With autumn the hazards change. Summer diarrhea is no longer likely to be contracted; respiratory and contagious diseases are more likely. Minor
respiratory diseases and some of the more contagious ones become dangerous due to complicating infection with various pus germs. This secondary pus infection extends often to the middle ear as otitis media, and less often but more seriously to the lungs as bronchopneumonia. Due to this pneumonic complication, whooping-cough is very often fatal throughout the first year or so of life; the disease is less common but much more serious then than in later childhood. It is only because of possible complication that common colds are hazardous.

The traditional prophylactic against minor respiratory diseases is the avoidance of chilling. Chilling undoubtedly retards recovery, and there is some evidence that it lowers the healthy person's resistance to such diseases. Protection from it is by avoidance of extremes both of warmth and cold. The baby which is bundled up and kept hot is the more liable to chill whenever it is accidentally exposed. These prophylactics are of secondary importance, however.

The baby's real protection against colds, just as against other contagious diseases, is in being kept away from infected persons. Whoever helps care for or plays with a baby during the course of a cold exposes it to the cold, and to consequent complications. Those who will not take the trouble to quarantine the nursery against persons with colds need at least entertain no delusions that they are safeguarding the baby by shutting off some harmless draughts. Danger always arises from mingling in crowds during the cooler months, for in outsiders a cold could not often be detected and avoided.

Contagion in Children.—Isolation from infected persons is much less feasible for school children than for babies. The child who is to associate with others at all can hardly avoid some contact with children who have colds. It is impracticable to isolate him very strictly even when he is suffering from a cold, though his associations with others should at this time be as slight as possible.

For the more serious contagious isolation should be strict. The presence of a sore throat, or of any of the highly contagious diseases other than colds, should exclude a child from all playmates, from school, and from any public place.
The symptoms of a cold will bear watching, for some of the infectious diseases of childhood may at first appear to be nothing more. In order that strict isolation for this more dangerous class of diseases be instituted as early as possible, parents should all have some idea of the beginning signs.

**Diphtheria.**—Diphtheria as a rule comes on with severe symptoms and is not then neglected. Atypical cases may begin with a sore throat and only mild general symptoms. The throat membrane is always reddened, but the characteristic patch of white film described in a previous chapter does not always appear. All sore throat cases are best isolated and seen by a physician, especially if diphtheria cases are known to be in the vicinity. The disease may also attack the laryngeal or nasal mucous membrane. Any hoarseness or croup, or nasal obstruction of an acute type, is suspicious unless otherwise explainable; it is particularly so if associated with general symptoms.

**Measles.**—An attack of measles may attract attention by a pronounced fever and aching, accompanied by catarrhal symptoms, or it may resemble at first an ordinary nose and chest cold. There is always some fever and usually redness about the eyes, with an aversion in the child to facing the light. Symptoms gradually become worse, and in a couple of days the membranes within the cheeks show small reddened areolæ about whitish spots (*Koplik spots*), which are characteristic of measles. In about two days more there appears about the face and neck a rash of scattered red spots, roughly circular and about \( \frac{1}{4} \)-inch across. The spots increase in extent and number and tend to coalesce; eventually the body may be practically covered with a blotchy eruption.

German measles does not have symptoms enough for recognition until the rash appears on the skin, and after this the condition is unlikely to be neglected as the rash is usually quite intense.

**Whooping-cough.**—Whooping-cough seems at first to be nothing more than a simple cold. A cough develops, which after a time becomes spasmodic. The child will then give a series of hard coughs without taking breath, inhaling finally with a long and noisy whoop. The spasmodic stage develops
most commonly in about ten days, but sometimes only after a much longer period, or not at all. An earlier diagnosis is often possible to the physician, who by laboratory test can often diagnose as whooping-cough a case with only the symptoms of a chest cold.

**Mumps.**—Mumps begins as pain or tenderness followed by gradual swelling beneath the lobe of one ear. For a few days the swelling continues to enlarge and causes pain on chewing; there is some accompanying fever. The other side, when involved, begins to swell a few days after the first. The condition is not likely to be overlooked by one who has in mind the possibility of mumps, though it may be confused with swellings from pus infection. Mumps may also occur beneath the lower jaw, in which position it is frequently confused with pus infection of the lymphatic glands there.

**Smallpox and Chicken-pox.**—In chicken-pox, the rash is preceded by no other symptoms, or at most by a slight feverishness for a day. Small reddened elevations, or papules, develop in the skin, usually over the face or trunk first. These change in about a day into small blisters, or vesicles, which can easily be rubbed off to leave a smooth red surface; meantime new ones keep appearing.

Smallpox differs from chicken-pox in the severity of general symptoms and certain differences in the rash, though in atypical cases the distinction may be difficult. The onset of smallpox is usually with severe aching, high fever, and vomiting or convulsions, all of which precede the rash by a few days. The lesions in the skin are deep instead of superficial as in chicken-pox, and would not leave a smooth surface if the vesicles were rubbed off. The change of papule to vesicle takes two days, as does then the change of vesicle to pustule, a much slower cycle than that of chicken-pox.

**Scarlet Fever.**—Scarlet fever in children nearly always begins with a rapid rise in temperature to 104° or 105° F., accompanied by vomiting and sometimes convulsions. The throat is somewhat sore and its membrane uniformly reddened. The next day a diffuse rash appears over the chest and neck, which if closely examined is found to be made up of tiny red points. Within a day, or often within a few hours,
the rash spreads over nearly the entire body. The very exceptional case may begin with a mild irritation of the throat and but slight fever, to be followed by comparatively little rash.

**Comparative Mortality of Infectious Diseases.**—Of these infectious diseases, three need hardly be feared; chicken-pox, mumps, and German measles do not endanger life. Neither does whooping-cough after infancy is passed. Among children who are immunized, as they should be, smallpox and diphtheria are not menaces.

The heaviest toll in lives is taken by diphtheria, due to a common failure of parents to obtain early enough medical attention. The mortality from scarlet fever, measles or whooping-cough is in some years higher for scarlet fever and in others about the same for the three. Measles and whooping-cough have a much lower percentage of fatalities among those sick, but they occur much more widely. The tradition that these two are relatively negligible persists from over half a century ago when scarlet fever and diphtheria killed almost four times as many children as measles and whooping-cough. The perilous practice of deliberately exposing children to them is fortunately being abandoned.

**Specific Immunization.**—Two of the contagious scourges can be controlled through inoculations which raise a specific immunity, and all children should be given these inoculations in time to antedate exposure. The first vaccination against smallpox is done preferably during early infancy, as the reaction to the vaccine is not then severe and susceptibility to smallpox begins in infancy.

Active immunization against diphtheria requires several months, and non-immune children should be inoculated in very early childhood. The greatest danger of diphtheria is when the young child begins to mingle with others. Those do not require immunization who are shown by a skin test (*Schick test*) to be immune naturally, though the immunity indicated might not persist throughout childhood.

Active immunization against whooping-cough has been widely attempted, but the results leave considerable doubt as to its efficacy. Encouraging results have attended an
inoculation of the serum of convalescents from scarlet fever and from measles to children who have been exposed to those diseases, though the procedure is still in the experimental stage. The other diseases of the group have as yet no specific preventives.

Avoidance of Exposure.—The fact that scarlet fever and diphtheria are so often milk-borne recalls again the matter of pasteurization. An additional preventive of contagion among children consists in their observance of certain hygienic habits. The child should be taught that whatever practices pass from another child any traces of mouth secretion are dangerous. He should be discouraged from biting off of the same ice cream cone or apple, from chewing the same pencil, and from mouthing the same toys as a playmate. The smoothly finished, so-called sanitary toys visit children's mouths more often than do fuzzy toys, and might presumably transmit more contagion. A child who has signs of a cold or other communicable disease should not play with other children at all, and the others should avoid him.

This sanitary regime calls for a complete reformation of childhood's habits, but the accomplishment of such a reformation is not hopeless. Our small children are taught dictates of decency which are unheard of among other civilized peoples and which they accept only when persistently dwelt on; they could quite as easily be taught the more important practices which prevent contagion. A rigid avoidance of others' mouth secretions would seem strange to most of them to-day, but this is because they are not taught.

Teachers of hygienic habits among children accomplish something by the health story, and more by continued insistence. Talks and stories attract the child's interest and link up health with the hygienic practices. It is then easier to insist on the practices. Health stories fit naturally into childhood. One which caught childish imagination many years ago was about little woolly caterpillars, or "fever worms," which according to old negro story tellers gave "the fever" to all who saw them; fortunately, the victims might save themselves if they would spit and touch wood. Children did spit and touch wood when they saw such caterpillars.
The modern story, with its sound foundation, can equally be relied on as a guide for habits.

**Tuberculosis.**—Hazards continue to change with the child’s advancing years. The contagions of childhood are gradually replaced, as most fatal of diseases, by tuberculosis. Tuberculosis presses forward to fourth, then to third, and toward the end of childhood to first rank, and from here it never recedes far.

The anti-tuberculosis fight in children cannot contemplate a total avoidance of the germs. All persons become exposed, and practically all develop small lesions of tuberculosis, though in most cases the tissues wall off or destroy the invader and allow it to do no harm. Safety is in proportion to the tissues’ resistance. When a child’s resistance loses all hold, the infection floods the system and terminates fatally, usually with symptoms of tuberculous meningitis. This occurrence is not common because the average resistance does hold the disease in check throughout childhood, even in cases which are to succumb later in life. The hygienic aim is to prevent such massive infection as the body might at the time be unable to withstand, and by proper nourishment, outdoor play, and avoidance of fatigue to build up the resistance.

Massive infection with tubercle bacilli can result from associations with a mother who has active tuberculosis. Such a mother not only endangers the baby when she insists on caring for it, but makes her own condition worse by the tax on her strength. The baby’s tissues are not resistant and quickly give way to such heavy doses of infection; in the course of time, perhaps after many years, this infection in them will make itself felt. Another source of massive infection, though not with the most dangerous type of tubercle bacilli, is the milk from tuberculous herds of cattle. Dangers from contaminated milk crop up at many places in child hygiene, and the importance of pasteurization applies most strongly to this period of life. Babies and children should not use raw milk of the ordinary market grade, nor ice cream or other products made without heating from such milk.

**Malnutrition.**—Poor nutrition of the child’s body signifies a doubtful resistance to tuberculosis. Malnutrition favors the
encroachment of tuberculous infection and such an infection, by reducing the tissues' ability to utilize foods, can aggravate the malnutrition. Malnutrition is indicated by a pallor of the skin and a sinking in between the ribs, or by a weight which falls 10 per cent or more below that averaged by children of corresponding age.

An average increase in weight runs somewhat as follows: The weight at one year is almost triple the birth weight, and that at two years 6 pounds more, or in the neighborhood of 26 pounds; after this the yearly increase averages 4½ pounds up to eight years, and 6 pounds during the few years following. This is only a rough statement of averages, from which there is variation due to sex, race, and other influences on the stature; a wide and unaccounted for deviation from it is suggestive enough, however, to recommend a physician's examination. About one-fifth of all American children are malnourished.

Predisposition to tuberculosis is but one of the hazards associated with malnutrition. Malnourished children cannot concentrate as long or learn as much as they could with normal nutrition. Their general musculature is weakened, predisposing to postural defect. Bad posture is encountered among children about as often as underweight, and to a considerable extent in the same children. Adenoids or other physical defects are more common in poorly than well-nourished children. Such children become referred to as "delicate."

In the management of malnutrition, three things are to be sought, the best possible feeding, plenty of outdoor life, and an avoidance of any fatigue. The diet has the general features of the normal diet previously pointed out, though the caloric values are not held down to the averages there stated. The three full meals a day may be supplemented by a mid-morning or mid-afternoon glass of milk with graham crackers, but not by irregular eating between meals which would spoil the appetite. The drinking of a quart of milk daily is strongly advisable for underweights. When the weather permits comfortable outdoor sleep, the sleeping porch is of service in their management. Day dreaming and
the reading of story books should give place to outdoor play, though in these children play should not be carried to the point of fatigue. A disposition to irritable and tearful moods often means that the child is being tired too much, by its play or otherwise.

Too much schooling is a source of fatigue for them, and it is better that they begin school too late than too early. Study during the vacation period is unwise. In the lower grades, the young mind does its full day's work in the school, and any outside school work or extra lessons in painting, music, etc., is to be discouraged. Brilliance of the child's mental accomplishments gratifies parents, but an apparent brilliance should not be bought at the cost of overwork. The mind is the master of the other functions, but it should not enrich itself at their expense. Overwork does more hurt to girls than boys, chiefly perhaps because girls are conscientious enough to do what is expected of them, where boys evade.

An ordinary school day proves fatiguing to the considerably undernourished, and is best replaced by a special routine in open-air classes. The routine should provide for the child's nutrition, for an outdoor day, and for the avoidance of fatigue. In some cities the children of such classes are all furnished with substantial meals at the school. A location beneath sheds on the roof, or in a room which can have one side entirely opened up, affords plenty of fresh air; in cold weather the children are made comfortable by warm wrappings rather than by the heating of the room.

The school work is shortened into relatively brief morning and afternoon sessions, between which intervenes the dinner and a long rest on cots. The rested minds do more and better work, in these short sessions, than the tired minds by plodding through a full school day. The malnourished child gains less from much work when fatigued than from little work when rested.

Physical Defects.—Defects other than nutritional also handicap the child in physique and in mind. The child who cannot hear all that the teacher says, or whose eyes tire before the lesson is read, naturally falls behind in its work. Neither the child nor anyone else knows why it fails until
the physical defect is looked for. Examinations of entire groups of school children always reveal many defects, and for the most part they are defects which had been unsuspected.

Defect of the teeth is the rule. Malnutrition, defective vision, and obstruction in the upper respiratory tract each claim over one-tenth of all children; proportions smaller than this have defective hearing, infections of the ear, or glandular swellings. Mental defects also occur in a small proportion of the children.

Sometimes there is encountered a most unfair reluctance on the part of parents to have their children's defects looked after. Some parents feel that surgery ought not to interfere with what nature has done, but it is only the hindrance to nature's workings with which surgery cares to interfere. Others, unable to pay for surgical procedure, have a queer sort of pride that is hurt more at the thought of sending the child to a free clinic than at the thought of stealing away its chance for health. Children with mental handicaps are withheld from a training specifically adapted to them, because parents wish that the child could get along without it. Realization of the full consequence of handicapped development would soon clear away any hesitancy to have the hindrances taken care of.

**Examination for Faults.**—A physical examination is the due of every child, for many curable defects could not otherwise be known. The children most obviously needing examination are those who appear in some way unusual. The child who is backward in school work, or is unruly, "nervous," or indifferent to the ordinary interests of childhood, is a child with symptoms of disorder. The one who sleeps with the mouth open, who tires easily, or who has any evident difficulty in sight or hearing, is another. The physical examination of these unusual cases will in most cases reveal something wrong.

If physical defects are not found, a psychiatrist might examine the mind for some deviation; no child should be assumed to be "mentally queer" without this being done. Sometimes he would find cause to recommend special educational methods. A child that is mentally defective cannot be
expected to make its own way in the world, as can other children. Probably one-half of the criminals are such because of a mind which could not develop as do average minds. What the trait is that makes the child unusual should in any case be determined.

**Play.**—Normal children do not need the sort of care advised for underweights, any more than they need the correctional measures for any other defect. Unlike the delicate ones, they can play until dead tired, and then sleep so much the better and wake up quite fresh. Plenty of outdoor play means for the healthy child a good appetite and proper rest, assuming that bedtime is early enough to permit a full quota of sleep.

Enthusiasm for play is the great building force of the child’s body. It springs spontaneously from an inherent developmental urge, and it serves to activate inherited powers of the body. Girls are driven instinctively to mother dolls, boys to hunt, and both to deal in their play with others; they unconsciously prepare for activities which the race has found profitable.

**Play-grounds.**—Communities are beginning to realize that since the child develops through play it must have a play-ground. In the congested parts of cities nothing more than a small play-ground is possible, and it is only with apparatus that active play can occupy all who congregate. The need for apparatus is inversely proportional to the area of ground available. Where the ground is sufficient for all the children to run about and play games, apparatus can be dispensed with. Play-ground directors attend the best ordered grounds to supervise games; they also see that the children use the apparatus properly and not for dare-devil stunts, and that the stronger children do not monopolize the apparatus.

**Dementia Precox.**—One of the bad influences which help to bring about adolescent insanity (*dementia precox*) is the abnormal restraint under which children of congested districts must grow. When there is no opportunity for the child to play, and the normal instincts cannot assert themselves, mental disorder tends more to develop. The occur-
rence of the disease is infrequent in rural and suburban districts where natural play-ground abounds. Fortunately, the danger extends only to those of a certain hereditary make-up. Inherited traits play a greater part perhaps in some types than others. The earliest symptoms of dementia precox appear as an extreme form of the silliness and dreaminess that often accompany adolescence; the patient becomes moody as time goes on, and signs appear of some form of insanity.

**Street Accidents.**—Street accident is another peril of middle and late childhood traceable to the absence of ground for play. The street is the only play-ground that many children have, and at the hours when they use it as such automobile accidents reach their greatest frequency. As boys play in the street more than girls, they are the commoner victims. In the sense that any driving in a play-ground is reckless, reckless driving is at fault; but often there is no other place to drive or to play. To correct the condition, other grounds must be found for children to play. Meantime, the only move is to teach children to be watchful.

**Direction of Play.**—The only essentials to play are the unspoiled natural instincts, some playmates, and a play-ground, but the advantages are greater if we add to these organization and the direction of an expert. Children’s play is imitative and seeks guidance; the boy does circus stunts after a circus has passed, and he plays games as he sees them played. The play which follows these haphazard inclinations does not bring the returns in health that the play guided by a director would.

The director’s planning must accord with the natural enthusiasms of the child, of course; accepting the urge of boys to compete, he merely plans the nature of the competition. His plan for choosing sides often adds to the competition, as natural groupings would put the stronger into one side. Other interests are similarly made use of; group dancing appeals more to the average girl than would a competitive exercise. Organized play disciplines in that rules are followed, and the character of the rules laid down determines the physical exercise done.
Summer Camping.—Direction of play is perhaps the greatest health building factor about the summer camps for children, though a less conspicuous one than the use of a great and diversified play-ground. The measure of health which the child brings home from the outing is the product of a director's planning. The aloof child who did not swim or play ball has been taught to do so, and been thereby drawn into the crowd. If he and others like him had been allowed to lie around and get homesick the camp morale would have slumped; success of the camp depends on the keeping up of a general spirit of doing. The personnel of the directing staff is the first item in the selection of a summer camp.

Camping of children in large groups has attendant dangers which are overcome only by strict medical and sanitary supervision; this is the second item in the selection of a summer camp for the child. If a physician is not in attendance, there should at least be a nurse on the ground and the services of a physician within calling distance. To provide for the occasional invasion of the camp by contagious disease, the hospital room or tent should be adapted to isolation. By a preliminary inspection of the children to be admitted, the bringing in of transmissible disease is largely prevented. The summer season in itself is a safeguard; epidemics of diphtheria, scarlet fever, measles, whooping-cough, smallpox or meningitis are usually in the colder months. Vaccination of the campers removes all danger of smallpox.

Sanitary provisions include such disposal of body discharges that there is no exposure to flies, nor drainage toward water supplies. Until the safety of a camp's drinking water has been assured by laboratory test, the water is best boiled. Ventilation needs attention, even in camps; that in a tent with its flaps down or in a room full of cots is often decidedly poor.

Swimming Pools and Beaches.—The swimming hole also harbors a few dangers to the child. The natatoria or beaches in the city are usually more of a problem than are the streams and pools in the country. The water transmits microbes, not only from any polluting sewage or ship waste, but also
from intestinal or pus lesions of bathers. Typhoid fever germs from a carrier or pus germs from a discharging ear infection or boil, could easily infect people in the water. This danger increases with the crowding of the beach or pool, and with the absence of current to keep changing the water. Chlorination of the water where feasible reduces this danger to a minimum; a 12-ounce box of bleaching powder per each 30,000 gallons of water is used daily.

Regulations should exclude all persons known to have any sort of open infection or to be carriers of any disease; others should provide that all bathers take a bath with soap before entering the water. Drowning is guarded against if the water be kept clean and transparent in natatorium, or if there are life ropes at the beach; life guards should be on hand at either.

Drowning.—In number of victims, drowning ranks high among the fatal accidents of late childhood. It is an accident more peculiarly of occupation, as the greatest incidence is among those whose pursuits bring them about the water. Among children, the coupling of an inability to swim with a love for the water is chiefly at fault. Children who live or visit near a body of water should all learn to swim, and until they can do so should go in the water only with responsible elders. It is best to learn in early childhood, though the attraction to the water and the drowning hazard are greater as age advances. An examination of the heart of all young swimmers should be made to safeguard them from cramps.

Burns.—The ranking fatal accident caused by the play of very small children is that due to fire. Fire looks very inviting to those in the first few years of life, who are making the acquaintance of all the new things they meet. One popular preventive is to burn the child's fingers and thus satisfy its curiosity, but this injures the child; it has no justification except that it does work. Fire of its clothes is extinguished most quickly by wrapping in a blanket; it is a good plan to have blankets handy at all times, even in the summer. As later childhood is reached, the risk of death from burns and conflagrations drops. Only under constant surveillance is the young child safe from accidents.
Accidents of childhood are more carefully guarded against, on the whole, than the general diseases, and therefore are not nearly such a menace. All accidents combined kill but a slightly greater proportion of our children than does tuberculosis alone.

Reading.*

* General, Rapeer, Chapter IV.
* Influences on the Child's Growth, Terman, Chapter IV.
* Infant Mortality and its Problems, Brend, Chapter III.
* Management of the Young Child, Scurfield, Chapter VIII.
* Mental and Moral Training of Children, H. D. Chapin, Chapter IV.
* Postural Development and Play, Cromie, Chapter III.
* Places for the City Child to Play, Curtis, Chapter VI.

* See bibliography for titles and publishers of books.
CHAPTER XIII.

HEALTH IN THE HOME.

Domestic Hygiene.—Domestic hygiene is that applied to the selection and management of a home. Housing conditions influence very notably the health of children and to a less degree that of older persons. Incidence and death-rate of tuberculosis and of contagious diseases, for instance, is lowered in proportion to enlargement of the living quarters. Housing conditions other than crowding also interfere with health. Bad ventilation of houses, or an infestation with vermin, leave their mark on the health of children by preventing normal sleep. Many more examples might be cited.

The individual's control of the situation has unfortunate limitations. Economic and social conditions compel people to live where they can afford to and largely as their associates do, rather than in any forests or mansions which they might perhaps prefer. Much can be done by anyone, however, to improve the sanitation of his own household.

Detached Homes.—The general drift of city people toward apartment life has its influence on their health. The flat partially solves the housekeeping problem as it is kept in order with less work, but this does not entirely overshadow the many advantages of the detached home. The latter has lighting and natural ventilation on four sides, and it affords a ground for the children to play. It permits a home life of privacy, more to be desired even than the fascinating pastime of piecing together the affairs of neighboring flat dwellers. The fire risk is lower, for carelessness by any of several families might burn the apartment. Multitudinous noises, the smells of cooking, and migrations of bugs and mice, all characteristic nuisances in the flat, can be excluded from the detached house. On the whole, hygienic considerations favor the house.
Location of the Home.—Local determinants of a healthful residential location are too varied for enumeration. The nearby presence of dirty railroads, noisy factories, and garbage dumps, though not demonstrably hurtful, is disagreeable. Congested neighborhoods are bad. The most healthful location is generally as far distant from the city's congested center as vocation and commuting facilities permit. Rural residence is commended by the outdoor recreation and other advantages which it affords. For those of the family who are not brought regularly to the city for their work or schooling, it exposes less to communicable disease. Given the same amount of health supervision, it has a lower rate of sickness and early death than has residence in the city. The suburbs hold the same advantages, in less degree, over the in-town residence sections.

The damp locality near a body of water is not necessarily unsanitary for residence, if it is breezy and comfortable. The lot should be high enough for the rapid drainage of waters from it, especially if children are to play there. Excessive moisture in the air affects health rather less than it does the house furnishings; musty and moldy odors, discolorations on the walls, and mildew on shoes and clothes result from too great humidity, as does also the rotting of woodwork and rusting or corrosion of metals.

The mosquito seeks moisture, and in zones of mosquito-borne disease the moist locality might be avoided for this reason; there also are chronic illnesses which physicians find to be aggravated by an excessively humid atmosphere. Humidity would not often affect health, if the temperature and air currents can be controlled to compensate. More attention would have to be paid to heating and ventilation, for high humidity renders half-heated houses inordinately chilly, and those without good circulation of the air inordinately close.

Heating of the Home.—Householders rarely decide without expert advice on a general heating system for the place, but those who are to employ the smaller heating devices need to know their respective hygienic merits. There is the fireplace, the stove, the electric heater, the gas heater, and the oil stove.
Fireplaces and stoves are the most economical in average localities, where coal and wood are relatively cheap. The advantage of the fireplace over the stove is that it draws air up the chimney and thus brings fresh air into the room by suction, that it seems more cheerful, and that it throws into the room a minimum of dust and combustion gases. The stove stirs the air of the room but does not bring in so much from the outside, and it is dustier than the fireplace. The stove is the warmer of the two because it loses less of its heat up the chimney and warms the room by convection as well as radiation; the radiant heat from the fireplace tends more to warm the face and leave the back chilled. Both are rather bothersome.

Electricity heats well, through the agency of resistance coils and reflectors, and is clean and easily operated; the expense is great though, and limits its use under average conditions to supplementary heating. The oil stove serves similarly as a portable heating unit; it is inexpensive but smelly.

Gas Heaters.—The gas heater is rather more likely than the other devices to imperil the residents' health, because of the emission of fumes. Except for fumes of unburned gas, the gas heater is not unhygienic. It is clean, promotes a desirable circulation of air, and requires no work. The degree of heat is readily controlled. It is the cheapest means of heating in localities about oil regions where natural gas occurs; natural gas is a relatively harmless mixture of which the chief constituent is the combustible methane, or marsh gas.

Artificial gas has a certain percentage of carbon monoxide which renders it more poisonous than natural gas. Bathroom water heaters burning gas have proved to be particularly dangerous, unless connected with a flue, because so many bathrooms are poorly ventilated and the cold metal of the heater at first chills the flame and hinders combustion. Products of a complete combustion of gas are not injurious, and the need for flues depends on the emission of unburned gases. Opinion is divided as to whether several other types of gas heaters ought not also to be equipped with flues.
Gas Poisoning.—Poisoning with carbon monoxide is usually a domestic accident, babies and small children being the commonest victims. Artificial gas is nearly always at fault, though coal and wood fires also emit fumes of carbon monoxide when not drawing properly. The same fume occurs in the exhaust from automobiles, and the running of engines in garages has often led to fatal poisoning.

Neglect or carelessness with illuminating gas is the principal danger. The gas is turned low and later blows out. The stopcock shutting off the flow is turned too far and lets it on again; or the cock at a droplight is turned off instead of that at the fixture, permitting the escape of gas through a leaky rubber tube. Combustion is interfered with by flaring, by filthiness of the burner, or in some types of burners by the burning of gas before air is properly mixed in—"striking back." Poisoning by gas is to be avoided by close attention to fixtures, keeping small children away from fixtures, and due regard for ventilation.

Ventilation of the Home.—The ventilating system in homes, together with the heating plant, is designed to facilitate comfortable elimination of body heat, as explained before. It contemplates also an improvement in the air's material contents. The air of the house is to be freed from offensive fumes, odors and dust. Through processes of natural ventilation, fresh air is brought from the outside to replace the air which contains any gas fumes, offensive odors, smoke, dust, or excessive moisture. The kitchen and bathroom in particular should ventilate to the outside and not into the rest of the house, for their air is most heavily charged with these nuisances. Slight odors arise from organic substances given off from the skin and mouths of persons in the room. Rather strong odors are emitted from the decay of mouth or throat infections, and in the case of unclean people from decaying matter and body waste in the sweat. Unless there is provided an hourly allowance of fresh air proportional with the number of individuals who occupy it, any room becomes close and unpleasantly odorous.

The rate of renewal of the air from the outside should not be great enough to cause uncomfortable draughtiness; such
draughtiness would result from living rooms having more than three changes of their air content per hour. A greater rate of change than this is permissible in bedrooms, where draughts are not so unpleasant. Three thousand cubic feet of air per person per hour has been recommended by authorities on the subject; where the ventilation is to afford only three changes hourly, this provision requires 1000 cubic feet of space per person ordinarily occupying. Bedrooms may be smaller if the occupants are comfortable in a draught.

It is not only by draughtiness that the bringing in of outside air can produce discomfort. On a hot summer day the inside air is cooled more through the midday hours by closing the house and turning on the electric fan than by opening up all the windows, and unless odors or fumes result this enclosed air is less objectionable than hot and uncomfortable air brought from the outdoors.

**Dust and Dirt.**—A large provision of air per person promotes health also by diluting any germs of contagion contaminating the mouth-spray coughed out or dust stirred up by those present. Dustiness is not a conspicuous hazard to health, but under some conditions it does predispose to respiratory, eye and skin infections. The dust problem is one less of ventilation than of house-cleaning. Dust should not noticeably fill the air, nor enough collect on furniture to soil the hands and clothes. Cleanliness has its greatest hygienic bearing in the nursery and playroom where children play on the floor, and in the kitchen where foods could be contaminated.

In general, a hygienic degree of cleanliness need not equal the spotlessness of refined housewives' ideals. The buildings in which the men and school children spend their working hours are by no means prim and immaculate, but they do not conduce to ill health. Sanitation of homes, as of other buildings, is exacting but not overexacting as to cleanliness.

**Housekeepers' Fatigue.**—The fatigue from cleaning and other housekeeping activities is itself an added hazard to those in imperfect health, as for instance any affected mildly with nephritis or tuberculosis. A fatigue which dominates the day's activity might engender in well housewives a
feeling of discontent, and a generally unhealthful mental state. Not only does the housewife face enough work to tire her out, but she is caught by the dread of endless duties lying ahead. The drag is not so heavy if she can look forward to recreation at the end of the day's routine, and the routine ought to be so planned as to permit this.

Fatigue and aversion to the work arise too from poor adaptation to housekeeping, due to bad training. Young women often train themselves for office work, in spite of an aim eventually to become housewives; on acquiring homes they are strained by the unskillful attempt at caring for them. Schools have attempted to overcome this difficulty by teaching cooking, the care of babies, sewing, etc., but such training can be only superficial. Domestic science courses bring science into the management of the home, but they do not provide the drill which will mean housekeeping ease and efficiency.

*Housework by the Children.*—Helping about the house therefore contributes to the welfare of older girls, if they are in good health. Fewer and fewer can look forward to being housewives without such work to do; incidental to our immigration policies it is becoming more difficult each year for the average family to depend on servant labor. Immigrating servant classes remain such only until American sentiment has inspired preference for work among equals, which takes about one generation. Negro servants have become fewer and less dependable than in former years and this tendency also is likely to continue.

Work about the house at the expense of their health should not be demanded of children. It would quickly tire the malnourished child and retard recovery. All of the younger children need as much play as their energies will stand, and housework in addition is too great a task. Unfortunately, it is also too great a task for the mothers in many homes.

*Sanitary Cleanliness in the Home.*—The home can be so planned as to cut down somewhat the work required for its cleaning. The scattering of small pictures over the walls or the use of intricately ornamented furniture adds little to the attractiveness of the place and much to the tedium of dusting
it. Hardwood or varnished floors are the easy ones to clean, or the kitchen floor covering of linoleum.

By sanitary cleanliness is meant simply the mechanical removal of dirt and odors. Fresh air and sunshine after the usual sweeping or scrubbing accomplishes more than the use of odoriferous antiseptics. The sprinkling around of antiseptic solution does little but raise a bad odor anyway; the solution must actually soak an object to sterilize it. Such solutions are of value only where undesirable living forms can be soaked and destroyed. A valuable one for this purpose is compound cresol solution, used in 1 per cent strength; it is highly germicidal and has but a mild odor.

The Antiseptic Fad.—The designation of ordinary household materials as "antiseptic" is principally a selling feature based on the popular regard for the term. Even shaving creams have been advertised as antiseptic. As cleansers for the teeth, tooth pastes are preferable to baking soda because they taste better, but the more advertised feature of pastes is the antiseptic quality.

So-called antiseptic or germicidal toilet soaps remove no more of the bacteria from the hands than do the less pretentious and cheaper soaps; some have inferior cleansing power and therefore remove fewer. Only the occasional person who carries disease need even think of removing germs when he washes his hands. Unless typhoid fever carriers wash their hands thoroughly after using the toilet they unconsciously pass the germs to others by their hands; for them an antiseptic need not be insisted on, and if used should come after washing rather than in the soap.

Spread of Contamination.—Occasional associates are protected only by the strictest of precautions on the part of a typhoid carrier; the closer associates should be immunized rather than take the chance. Carriers should have their individual soap and towels, and avoid so far as is possible the use of any article in common with others. They should in all respects keep scrupulously clean. The carrier condition is not quickly gotten rid of, even under treatment; the germs sometimes continue to be carried for as long as ten or twenty years, though this is exceptional. The carrier should avoid
even the passing of foods to guests at the table and keep out of the kitchen altogether. One of the common sources of small typhoid fever outbreaks is the carrier in the kitchen; outbreaks in one family after another have followed the wanderings of a carrier employed in turn by them as cook.

Precaution against other infections is similar, though exclusion from the kitchen is necessary only for the intestinal group. Use of towels and such articles in common with others might easily disseminate the germs of discharging pus infections or of skin disease. The best protection is to keep persons with such lesions from the house. When the history of a newly employed servant is not known, it is the part of wisdom to have her excretions examined for typhoid bacilli and at the same time to have any suspicion of tuberculosis, venereal disease, or skin infection put at rest by a medical examination.

Washing of Dishes.—Considerable comment has centered recently on the possible transmission of respiratory disease by dishes. Ordinary washing and wiping of dishes does not sterilize them, and germs can remain on a dish or collect into the dish towel for transfer to another. The dishes used by patients with tuberculosis have been found after washing to retain virulent tubercle bacilli; germs of acute sore throat and other conditions appear also to live through the process. All public eating houses are required by some communities to have the dishes washed in very hot water by a dish washing machine; this is a wise ruling where a plate used by one rush-hour patron is hurriedly washed and put before another.

Such transmission of mouth contamination is possible in private homes if an infected patient or carrier is in the house, though there are many readier avenues of transmission. The plate which is passably cleaned, wiped, and put away until the next meal, is less dangerous than the air of the room where the patient sits. Sloppy washing of dishes in the home appears not to transmit disease to any extent. It does breed carelessness and in other minor ways is objectionable. A more sanitary method is that by which the dishes are rinsed in a pan of very hot water after washing, and then set aside to dry by evaporation. Drinking glasses used by person after
person, and not washed at all between, are much more likely than the dishes to transmit any contagion that someone in the house might have.

**Safe Water and Ice.**—In communities without a properly supervised water supply, or in rural homes, the danger of infection often lurks in the water itself. Drainage from excreta wash over the ground and into the well, either about the pump or through fissures in the soil; the shallow well on low-lying ground is most liable to pollution. Unless laboratory test dispels suspicion, such water is safe for drinking or for the washing of foods only when boiled.

The practice of icing water has been criticized because of possible pollution from the pond from which the ice was cut. Freezing for a period of months is unfavorable to bacterial life but it does not kill all bacteria, especially where the ice is snowy with air bubbles. The danger in America is a rather remote one, though polluted natural ice has caused typhoid fever here. Artificial ice is of course free from this danger.

It has been thought by some that iced water is chemically or physically unsuited for drinking, particularly for those overheated by exercise. The only demonstrable objection to heavily iced water is that it chills the throat unpleasantly; the assumption that there are likely to be bad after-effects is hardly confirmed by experience. No harmful chemicals are present in the natural or artificial ice of the market.

**Cooling of Water and Food.**—Such cooling in the summer as makes drinking water palatable commends itself, just as does the cooling of butter. Where ice is not available, a degree of coolness for foods is obtained by pits dug in the ground, by water running from beneath the ground, or by containers cooled by draughts and evaporation. To employ this last method, a small pan containing the food is placed in a larger pan of water, a coarse cloth covering the small pan and hanging about it into the water; when this device is placed in a draught, the moisture in the cloth keeps evaporating and absorbing heat from the container, and meantime more moisture draws into the cloth by capillarity.

The ice-cooled refrigerator, while superior to the crude
devices just mentioned, often fails to cool well. Cheaply made refrigerators have variable humidity and, what is worse, variable temperature. Points of good construction include insulation, means for circulation of air, and a relatively large ice chamber. Even the properly constructed box is at its best only when well stocked with ice. A thermometer should be used to control the temperature, all foods being kept below 55° F. and some, including milk, at least 10° lower still. Unless one of the shelves for food registers such a temperature, milk and other articles which support rapid bacterial growth are best kept in the ice chamber. Meat should not be kept directly on the ice as it absorbs moisture there.

**Safe Meats.**—Cooling of foods in the kitchen is more than they may keep longer and taste better than for the prevention of disease. Only in the case of milk has the latter been shown to be a real factor. Decomposition of meats appears not to endanger health, for development of poisonous decomposition products (*ptomaines*) does not occur until after that of a disagreeable smell and taste. The decayed protein is unfit for food even though disease is not a proved danger; bad eggs have never poisoned anyone, but nobody wants to eat them. It is possible that the warmth and other conditions which hasten decay could also favor the growth of any infective bacteria that chance to contaminate the meat.

Meat killed and delivered directly to the butcher is not subject in this country to any sanitary regulation, and is more likely to harbor germs of disease than is the meat killed at large plants and kept in cold storage until delivered. Not only does the U. S. inspection in such plants keep much of the dangerous meat from the market, but cold storage is an additional safeguard. The freezing temperature slowly kills bacteria, and it more rapidly destroys larvae tapeworm. The trichina withstands freezing longer, but cannot live more than a few weeks through the storage temperature below 12° F., where a suspected meat should be placed. Cold storage makes meat tenderer, and for most people improves the taste. Meats from animals killed locally are more likely to be infected with animal or bacterial parasites.
Butchers have sometimes sold meat from animals killed because of tuberculosis or acute infection; if not cooked until well done throughout, such meat could transmit tuberculosis or the diarrheal type of food poisoning.

Meat may also be bad due to improper handling while in the butcher shop. In making chopped meat, butchers have been known to use all sorts of scraps, including not only meats of a different sort from that represented but also meats on the point of going bad. Unless the butcher is known to be reliable, it is safer to buy desired cuts and chop them at home. Contamination also reaches meats and other foods from flies and general handling, unless the foods are sheltered; those foods which require no further cooking need sheltering more than raw meats.

**Kitchen Precautions.**—Activities of the housewife which would safeguard the healthfulness of what she serves, in brief summary, are: (1) The exclusion from the kitchen of infected persons or carriers; (2) care in the selection of foods and water supply; (3) the heating before serving of any suspicious water, milk, meat or canned goods; and (4) general cleanliness. Cleanliness is perhaps most essential in putting up canned foods, as this is the primary preventive of botulism.

Corrosion of kitchen vessels is not the common source of poisoning it was once thought to be. Verdigris could hardly prove to be poisonous in the minute quantity that mixes into a food from properly cleaned vessels, even though copper should come into contact with the food. There is no greater danger in the fact that tin is dissolved into so many canned acid foods, for as in the preceding case the quantity never reaches poisonous proportions. Cheap grade enamelware might impart antimony to foods, but also in non-poisonous amounts.

**Garbage.**—The standing about of neglected food waste does not lead to disease; it is unsanitary principally because it attracts flies, roaches and mice. The disposal at home of wet garbage is best brought about by burning, unless there are chickens or other animals to be fed. Garbage can be quickly dried and charred in iron baskets constructed to fit into the lower stove pipe, though such a device is superfluous with a fire hot enough to consume it immediately.
Nearly all large communities maintain public systems of garbage disposal. In some cities ashes, dry rubbish, and kitchen waste are collected into one wagon. In others the ashes are not removed by the municipality at all. In still others the rubbish and the kitchen waste are removed separately. Local conditions determine the best collection system, and with whatever system is in force the householder should carefully cooperate.

Wet kitchen waste ought in any event to be kept until collected in a tightly covered can which permits no ingress of flies or mice. Compound cresol solution poured into the bottom of the can when emptied helps to check the decomposition of food residues or the breeding of flies.

Insect Pests.—The riddance of insect pests and other vermin is by elimination of any food supply and breeding ground for them, by the proofing of houses against their entrance, and by destruction of those that do get in. All within the house may be attacked on a large scale by fumigation. Fumigation, at its best, rids the house of roaches, bedbugs, flies, mosquitoes, ants, fleas, and lice, as well as of rats and mice. The insects which do not fly can be attacked on a small scale by the use of petroleum or kerosene. These oils, or certain disinfectant solutions, or boiling water, are all insecticidal, but they kill only the insects which they can actually soak. Their use is adapted to the cracks in furniture; pests might be diminished in number sometimes by their use in cracks about the floor or walls.

Fumigation.—The most effective, but in unskilled hands the most dangerous, exterminating procedure is fumigation with hydrocyanic acid. The gas is exceedingly poisonous to all forms of animal life; many fatalities to human beings have resulted from its use. A comparatively safe fumigant is the gas evolved from burning sulphur. After the sealing with gummed paper of all cracks about windows and elsewhere, ordinary sulphur is broken into small lumps in a pan, 2 to 4 pounds being allowed for each 1000 cubic feet of space to be fumigated. This pan is put into a tub which contains a little water, so that the spluttering of burning sulphur might not set fire to the place. A few ounces of alcohol is
poured over the sulphur and this lighted. After exit is made, the last of the cracks are sealed and the place left until next day.

The gas evolved is destructive to insects in either dry or moist atmosphere, though one fumigation usually fails to kill all that are present. Sulphur has but a fraction of the efficiency of hydrocyanic acid gas. In the presence of moisture it is injurious to many metals and fabrics. In spite of these disadvantages, it is the best method of fumigating for general use against insects. In bactericidal power sulphur fumes are inferior to formaldehyde fumes, but the reverse obtains as to insecticidal power.

**Flies and Mosquitoes.**—Mosquitoes are best reached through the control of their watery breeding place, wherever that may be. The one which transmits yellow fever, and probably dengue (*Aedes aegypti: Stegomyia fasciatus*) breeds by preference in vases, old cans, barrels, and other receptacles about the house; its control depends more on the householder than does the control of the malaria mosquito, which breeds in the broader expanses of water. The most prolific breeding place of flies is the collection of manure about stables; they also breed in garbage and other decaying organic matter.

Mosquitoes and flies, as well as other flying insects, are kept out by screens or exterminated by swatting. Sticky paper is fairly effective against the fly, but the traps available have proved less so. Flies should be attacked early in the season; few live through a cold winter, but unless these few are killed enormous multiplication takes place as warm weather comes on. Houses too often are insufficiently screened, and the householder should see to it each year that no open space remains about screen doors and windows. Netting is sometimes needed over the bed in addition, when mosquitoes are bad; it is also useful to protect the baby when sleeping in the yard.

**Mice and Rats.**—Rats and mice, in addition to having other offensive qualities, are transmitters of disease. Germs which cause the diarrheal type of food poisoning are in some cases carried by rats and mice, and from the bowel passages of the rodents reach the food of human beings. Infectious
jaundice is brought from the rat to man, apparently through the same transmission route; this is an epidemic disease of the rat and of man which prevails widely in Japan and has also invaded America. Foods should be protected from the trespassing of rodents. The rat is the natural victim also of bubonic plague and trichiniasis, and occasionally of rabies; these infections also are passed on over various routes to man.

New traps of the trigger and strong spring type commend themselves for the extermination of rats and mice; used traps are less to be depended on as the animals avoid traps which bear the odors of previous use. Exclusion of rats is brought about by the rat proofing of houses, though mice manage often to be carried past the barrier and then multiply in the house. To exclude rats, any openings into floors and walls from about the foundations are closed with cement, and to avoid harboring them in piles of lumber and junk about the house, these are put in order and raised from the ground on trestles.

**Household Pets.**—The odor of cats and dogs deters rats from invading the house, though these pets are too well fed as a rule to care much about rats and mice. Dogs and cats may themselves transmit disease. Rabies is acquired and passed on to man by either of them, more often the dog. The common tapeworm of the dog (Dipylidium caninum), which is also common in cats, has been transmitted through the dog flea to the intestines of children, in which it can then develop. Echinococcus disease is contracted by people in play or other association with infected dogs.

The worm called echinococcus (Echinococcus granulosus) is a member of the tapeworm family, and is the member which creates the most serious human disease. The adult lives in the intestine of dogs and not like the pork, beef and fish tapeworms in that of man, but because its larva invades human tissue it is a far greater peril. The larvae in human tissue often die there, but sometimes their development continues until the disease reaches a fatal termination; the only active treatment is surgical removal of the encysted larvae.
Cats and dogs have many good points, chief among which is their companionship for children, but they are safe only if closely watched. They should be kept free from intestinal worms and other infections, and as free as possible from fleas. The anti-flea crusade by owners of dogs is a continuous one. Treatment of the animal’s infections by worms or other parasites requires some skill, and unless the owner has had considerable experience with animals this is best put in the hands of the veterinarian. Many have brought misery and even death to their dogs by a more or less regular diet of cathartics and other unnecessary drugs. Neither animals nor men thrive on unskilled doctoring.

**First-aid Kit.**—For children and others of the family, the promiscuous administration of drugs affects health adversely rather than favorably. The household medicine chest is almost a thing of the past, and it should be. The practice of accumulating medicines has nothing in its favor. Drugs are rarely helpful except for a condition under treatment by the physician, and any remains of them are useless after the illness has passed. The medicines worth keeping are only the few for emergencies, which find a place in the first-aid kit.

The first-aid kit for the household need not be nearly as well stocked as that for industrial plants. Much of the emergency treatment for poisoning can be provided from the kitchen, and much of that for mechanical injury from the sewing-room. The kit is needed principally for superficial cuts, lacerations, and burns. It serves but a small part of the general field of first aid, the essential to which is the idea of what should be done; materials can usually be found with which to do it.

The household kit should have a few packages of sterile cotton and of sterile gauze, some gauze bandages, a spool of adhesive tape, a clinical thermometer, a bulb or “ear and ulcer” syringe, a few medicine droppers, and a hot-water bag. A few remedies to be included are plain petrolatum, tincture of iodine, a solution of one of the silver antiseptics such as 15 per cent argyrol and some crystals of potassium permanganate and of boric acid, to be dissolved when
needed. Possibly a dose or two of some purgative for use in case of poisoning would be worth including.

**Reading.**

*General,* Pyle, Section by D. H. Bergey.
*Healthy Homes,* Scurfield, Chapter II.
*Health, Land and Housing,* Brend, Chapter V.
*Bacteria and Poison Gases in the Air,* Rosenau, Section VI, Chapter IV.
*Adulteration of Food,* Woodman and Norton, Chapter VIII.
*Extent and Kinds of Food Poisoning,* Jordan's Food Poisoning, Chapter I.
*First-aid for Surface Injuries,* Lynch, Chapter IV.

* See bibliography for titles and publishers of books.
CHAPTER XIV.

THE MODERN HEALTH MOVEMENT.

Responsibility for Health.—Individual hygiene is at many points inseparable from the public welfare. The regard for health is the person's own privilege only insofar as the weal of others is not interfered with, and even his own physical condition affects the community, for his work must repay it for sustaining him. The agitators for public health can fairly assert that the maintenance of one's health is a moral obligation as well as a personal privilege. They cannot stipulate how each is to live, for all individuals' needs are not uniform, but they can demand a generally responsible attitude.

A sense of responsibility has not yet developed in children and is often not present in those having a deficiency or derangement of mind, so these people cannot be expected to control their health; the burden is shifted to competent guardians. Those who are capable but simply too lazy to maintain judicious health standards cannot be given this justification.

Hygienic Standards.—All mental competents have health principles of a sort, but the principles of many are based on momentary inclination rather than studied foresight. These prefer to gamble for their health, feeling that the odds are in their favor anyway, as the inherent elements of defense are strong, and that neighbors might be expected to lend a helping hand in emergency. Without bothering about health laws, they drift along and do as others seem to be doing; all goes well unless they chance to hit a snag.

When ailment comes they find a fad, developed from someone's chance impression of his experience. Excessive exercise is indulged in, with a view to working an infection out of the
system. They “don’t give in to the invader, but stay at work through sheer will power and brave it out;” that kind of sheer will power is often what delivers them to the invader. The neck wrappings for sore throat might be commended, as they warn sensible passers by of contagion, but they are not worn for that purpose. Some careless person had started the fad and they simply picked it up.

Health and Intelligence.—Only from the more careful observations of human experience can the mind construct a real defense against the antagonists to health. Actual causes must be related to actual effects. Lack of such background has misled thoughtful as well as thoughtless persons. Some have drifted into the loose thought that all illness originates in the mind and is to be overcome simply by a different sort of thinking. Ills of the imagination have indeed been so cured, but not the havoc that is wrought by the germ of diphtheria and other disturbers of tissue. To have power over bodily health, the mind must appreciate and meet the body’s physical needs.

Only with a basis of scientific hygiene can the individual meet his responsibility to the community, and relieve it of the necessity of issuing hygienic prohibitions to him. The right of others to prohibit anything from anyone is derived from the failure to fulfill obligations. How much justification there is for the prohibition of drugs or alcoholics depends on whether women and children must go hungry because their providers squander the week’s pay and otherwise neglect life’s responsibilities under the depressant influence. Control of his habits is a fundamental privilege and a duty of every individual who is mentally competent; if he accepts the responsibility for health, the control may be left with him.

Expert Aids.—The obligation to guard his health should not even be negotiable, though some would have it otherwise. There are those who would pay their physicians so much annually to baby them along in health matters and free them from the care, but such a scheme is neither ideal nor generally practicable. The health of lower animals and of immature human beings must be controlled by heads wiser than their own, but we like to think that human adults could take
care of themselves. The fixed annual fee system has been described as a model one in wide practice among the Chinese, but this is a myth. Foreigners in China and in other places removed from the medical world contract with their physicians by the year, but they regard this as an unavoidable makeshift rather than a model system. It does not encourage prevention, or if it does it is only by shifting the responsibility from careless shoulders.

The individual is the one who actually controls his life habits, and he can be guided much better by understanding than by a physician’s orders. His rightful dependence on others is for preliminary enlightenment and for aid in those emergencies which of necessity lie beyond his control. He should know where his limitations lie, and beyond them how to select wisely the skilled aids on which he must depend. Scientific men have specialized in many fields of health work, and afford him the use of their expert and technical skill.

**Patent Medicines.**—The aid proffered as expert is not always *bona fide*. The falsely pretentious patent medicine is sold under a pretense of scientific composition, and its ridiculous promise of healing potency is couched in medical phraseology. Investigators who produce remedies of real worth are more likely to publish their findings for the use of all humanity than to burden the patent office with them. The fake medicine is not actually patented either, nor in many instances do all the bottles have sufficiently uniform contents for patent, but it has a registered trade name and has come to be known as the patent medicine.

The deception practised in the advertisement of these preparations has been widely exposed by public-spirited periodicals of recent years, and many publications have refused to accept their fraudulent advertising. The activities of the Post Office Department, of the enforcers of the Food and Drug Act, and of various public health authorities, have further restricted the traffic.

The proprietary medicines advertised to physicians only are by no means as great an evil, for the physician’s training saves him from being misled. The profit accrues to the pro-
prior, as in the case of the patent medicine, but it is not this feature that hurts. An objection to these latter preparations is the encouragement they give the physician to prescribe mixtures which approximately meet his patient’s requirements, instead of bothering to remember his therapeutics and meet the conditions precisely. Another bad feature is the possible misuse of physicians’ reports on occasional patients who do well while using the treatment; such reports could be published by the proprietor company later as typical ones, should the advertising campaign be extended to the general public.

Quack Doctors.—A more extortionate swindle than the patent medicine traffic is that of the medical quack, or self-advertiser. Some quacks advertise in the local papers, designate themselves as specialists, and solicit the diseased to call at their offices. Others advertise far and wide, and solicit only correspondence; they promise to cure conditions without even having seen them, and claim that diagnosis is possible from a filled-in questionnaire.

The chief peril lies in the unscrupulousness and low medical caliber of the men in whom the victims come to place their confidence. The man who descends to quackery is the decidedly low-grade physician, or sometimes is not really a physician at all. Most of them operate in greater or less violation of the laws of their communities. Medical men whose experience and skill is such as to rank them as real specialists in any branch would be the last to advertise in the papers.

Persons of limited means are led by “free examination” offers to think that the service will cost but little; after the examination they are frightened into parting with all their savings for unnecessary treatments. Others, who are averse to having their complaint known, are struck by the word “confidential” in the advertisement; the quack is the only physician who is likely to betray confidences, however, and some unrevealed chapter of a person’s affairs offers golden opportunity for blackmail. Letters received in response to advertisements are sold to letter brokers, to be rented out to any other swindler who wants a list of easily deceived people.
Medical Systems.—The practice of quackery enters into several "medical systems," built on this or that pseudo-scientific fancy. The medically untrained practitioners may or may not first guess at the nature of the patient's illness, and then they proceed with some more or less imposing semblance of a treatment.

Characteristic of such systems is a fairly complete disregard of all careful observations on phenomena of disease. Their proponents decry State Laws which would require any extended amount of study as a prerequisite to practise; their aim is to collect fees rather than to overcome sickness.

Some who advocate the right of the untrained to take medical fees have loosely leagued themselves together to fight for "medical freedom." They clamor about despotism, and imply that doctors of medicine form a closed alliance which forbids any outsider to practise. Quite to the contrary, the medical world is in no sense exclusive and would have all capable persons free to practise medicine. It knows and insists, however, that years of intensive study must underlie any capable direction of the conflict with death. The demand that practitioners be well trained is purely for the public interest; it is an insurance that those who treat a disease will know of the several factors involved.

The respective medical systems endanger the public in proportion as their practitioners lack understanding. The old discordance between homeopathy and regular medicine is tending to disappear as the homeopathic colleges bring more scientific training into their courses of study.

Regular Medicine.—Regular, scientific medicine has no orthodox principles of healing by which it differentiates itself from heterodox bodies; it is not a system based on any unique tenets. Its basic principle corresponds with that of any true science; it is to relate together all observed facts about the body and its diseases. False concepts will be weeded out, simply because they are out of keeping with other known facts. Any conflict in findings between different observers is tediously studied until the error appears. Medical science aims to interpret all of humanity's experience of health and sickness.
The general practitioner has a broad grasp of the entire field of medicine. The management of conditions which require extraordinary skill is referred to the specialist who devotes himself more largely to that one class of conditions. The family physician can manage most cases quite as well as the specialist, and with much less inconvenience and expense to the patient. The growing tendency of patients to go directly to specialists has created a demand for over-specialization in medicine; young physicians are tempted to specialize early in one field and neglect the others, instead of superimposing any favored specialty on the broad experience of a general practice. The family physician is the best judge of which cases need the specialists’ care.

**Medical Advice.**—The physician’s contribution to the building up of diseased organs is advice, which it is then the patient’s responsibility to put into effect. The patient is still accountable for his health, though now he must not act entirely on his own judgment. A prescription of careful diet and tedious exercises, with possibly a medicinal mixture for some minor effect, cannot be expected to give results if the patient takes the medicine and neglects the other parts of the advice.

In some ailments, the advice is that no known treatment can aid the recuperative powers of the body; in such a case it is useless for the patient to try one remedy after another. If the condition is not to improve right away and cannot be hurried, the logical management is to wait for it; its eventual cure should not be credited to a few bottles of whatever nasty fluid happens to have been taken in the meantime. The fondness of some people for medicinal treatment becomes almost a mania. They want treatment for a pulse-rate which differs from the average, or any other peculiarity which they chance to find; when the family doctor offers none they appeal to the quack. The disciples of “medical freedom” are found more resourceful. An unreasoned acceptance of professed healers has this danger, that false standards are not distinguished from true.

**Work on Animals.**—Many false standards have appeared commendable to the thoughtless. Among these is the anti-
vivisection fanaticism. The practice of vivisection is taken by some people to indicate cold-hearted or even brutal impulses. The investigator is thought of, together with the boy who throws at birds and the dog that kills chickens, as one dominated by the primitive impulse of carnivora to inflict pain and destroy life. On the contrary, only the mind which has attained a fair plane of altruism would be attracted to scientific medicine. The medical man feels that men, women and children should be relieved of suffering and premature death, at the expense of animal life if necessary.

Even so, the animal experimenter is not the tormentor of animals that his adversaries paint him. A familiar rule in animal laboratories requires that anesthetics be employed wherever an operative procedure would cause more discomfort than the anesthetization; only in the occasional experiments of such nature that their results would be vitiated, are exceptions made. When the animal's death is necessary, it is not commonly one of suffering.

Domestic animals drafted into laboratory service have their life prolonged or their lot otherwise improved in many instances. Sheep, for example, are kept for the occasional use of a little blood, instead of being slaughtered for food. The more customary laboratory animals, such as rabbits and guinea-pigs, lead also a generally comfortable existence; they live in much less fear of the scientist than did their wild ancestors of larger beasts. Many of them now are bred only for the laboratories, and if this use of them should cease they would not taste of life at all.

Modern medicine and hygiene depends greatly on the employment of living animals for experimentation and other purposes. Animal experiments have made possible the perfection of treatments, by which are cured innumerable attacks of sickness which would otherwise have proved fatal. Animal work is necessary also for the routine prevention, diagnosis, or treatment of many diseases. The lives of non-immune persons who have been exposed to smallpox, rabies, or tetanus are very greatly endangered unless specific measures are taken, and these measures involve the operative use of cattle, rabbits, horses and guinea-pigs. The Wassermann
test for syphilis, and diagnostic tests of the same nature for other diseases, depend on the use of living sheep, rabbits and guinea-pigs. Guinea-pigs are used for the accurate diagnosis of some forms of tuberculosis, white mice for that of pneumonia, and rabbits for that of the typhoid carrier condition. The use of horses, guinea-pigs and other animals enters into the manufacture of curative sera. Dogs are indispensable for some procedures, including the development of new surgical operations and of dexterity in the performance of old ones, which otherwise would sometimes be at the expense of human life. These are but a few of the many purposes for which laboratory animals are used. The anti-vivisection prejudice, if ever it should dominate legislation, would militate disastrously against progressive medicine.

**Autopsy.**—In many kindly intentioned people also there has developed an unfortunate sentiment against the autopsy of deceased persons. The nature of a disease becomes known through the study of tissues which this disease has attacked. What knowledge we receive of this comes from postmortem examinations. The one desire of physicians asking permission to do an autopsy is to ascertain and record such data as will clear up uncertain points, and correlate physical findings on the patient with the actual tissue reactions. Such information as this finds its way eventually into the written science of medicine. The sentiment which would have such a memorial of one's deceased relative built into science, to save life in future generations, is surely finer than the sentiment which holds back in order that the body's form might remain complete for a short period after burial. Embalming can be done just as well after autopsy, though it takes a little longer and is more difficult for embalmers who are poorly trained.

**Sentiment and Health.**—Sentimental shortsightedness can jeopardize health at many points. Patients with open lesions of tuberculosis insist on keeping in their presence healthy babies, and ignore the protests of health authorities who would remove a baby to save it from the disease. When children begin to chafe under the restriction, quarantine regulations are allowed by parents to be broken, and con-
tagion and death to be spread to friends. Kindly motives are prone to misdirection, unless enlightened.

When enlightened, on the other hand, such motives form the real back-bone of accomplishment in the advancement of health. By their very nature they expand individual into community hygiene. What the public health movement most needs is more of such sentiment as would promote intelligent coöperation. Underlying setbacks to most programs for public welfare have been a disregard for the welfare of others coupled with an ignorance of the issue.

Public Health.—Everyone should comprehend the goal of the principal public health activities. Most of these are conducted by organized authorities which function under the local, State, or Federal governments, or under privately endowed institutions.

The State governments have the greatest power over American public health. As most health problems are local in character, however, the legislatures delegate their control to the respective local communities; this is done through statute or provision in the municipal charters. A State Board of Health coöordinates the work, acts in intercommunity affairs, advises local authorities legally, compiles vital statistics, maintains laboratories for the smaller communities, etc. Local authorities are expected to look after the control of communicable disease, to have data registered for vital statistics, to guard the purity of public food supplies, to abate nuisances, and otherwise to safeguard the public health. Prime responsibility for a department's conduct lies with the health officer, variously entitled, the amount of whose assistance depends on the size of the appropriation.

Federal Activities.—Federal activity in health matters is concerned primarily with interstate and foreign problems only, but its influence is everywhere felt; it often comes into the State's own confines by invitation. The Government's health projects are distributed for execution among several of its departments, though at times the advisability of a consolidation has been considered.

The Public Health Service under the Treasury Department, by inspection of immigrants and the quarantine and fumi-
gation of ships, prevents importation from foreign countries of infectious diseases. The Service also operates the Hygienic Laboratories, inspects for purity the antitoxins and vaccines sold through interstate commerce, and publishes much general information on health matters. The Bureaus of Chemistry and Animal Industry under the Department of Agriculture include among their activities, respectively, an oversight of the pure food regulations, and an inspection of meats and investigation of dairies. Statistical material useful for the guidance of health campaigns is collected by the Bureau of the Census in the Department of Commerce. Child and infant welfare is investigated and promoted by the Children’s Bureau of the Department of Labor. The Departments of War and of the Navy do active sanitary work in areas occupied by their forces. Important though less extended health work is conducted by other departmental agencies.

Public Support.—The first of the demands made on the public by these many activities is that they be adequately financed. The scope of the local health work done is governed by the appropriation, and in all communities more funds would bring more results. It is generally true, though rarely appreciated, that large appropriations for health work would prevent economic losses represented by a still greater figure. Not infrequently it is only by the help of philanthropists that the most necessary work can be done.

A vote for increased taxes for health work does not, however, fulfill the individual’s whole obligation; adequately financed work can have its effects dwarfed by public indifference. People accept without thought the advantages afforded by community life, and forget that some moral responsibilities go with them. Foremost among these are the hygienic, a disregard of hygiene being much more harmful among many people than among few.

Eradication of Disease.—Nearly all campaigns for the eradication of some disease from a community have been impeded by public indifference. Eradication of the hookworm demands merely that nobody go barefoot for a time, that bowel discharges be properly disposed of, and that patients diagnosed as having the disease take treatment. Unfortu-
nately, it is among the relatively untaught that hookworm most prevails, and commissions find that such people insist on their own way of dressing and of excreta disposal, that they are insulted if told that their leisurely habits are due to worms, and that they will not trouble to come for treatment. Yellow fever eradication demands that there be no breeding about the houses of a certain mosquito, but in spite of the sanitarians' appeal water continues to stand in cans thrown into the yard. Stamping out of smallpox epidemics by vaccination has always been hampered. Many who stand to gain most from the campaigns show the least enthusiasm for them.

Vital Statistics.—It is not only the untaught whose cooperation fails to materialize. Consider as an instance the collection of material for statistics. The charts for the conduct of health campaigns are drawn from statistics. Many conditions of life bear on the conflict of tissue with disease; age, race and occupation influence the issue less directly but often as really as does a wide prevalence of the germs. When the communities are charted, all these conditions are entered. Data are registered in the health office, and other data are collected through the United State and local census by house to house canvass. Registered data include deaths and their causes, births, and the occurrence of certain of the diseases; the proportion in the community of old people, of or negroes, or of indoor workers, is learned through the census. Private canvasses are frequently made for various other information.

Too often the registration of facts wanted is neglected, or the census takers are avoided. Many would withhold from investigators all personal information. The most influential people of the community are often the worst offenders. Statements made to census takers are offhand and careless. A third more people state their age at thirty, or forty, or fifty years, than at thirty-one or any other intervening figure; in a hurried brevity they do not pause to think what their actual age is. The value of any chart depends on its accuracy, and the accuracy of these charts requires public cooperation.
Child Welfare.—A field of health work now coming into prominence deals with the welfare of children. Probably no work depends more than this on wide popular support; even its supervision must have the effort of others than the health authorities. It has called forth the united efforts of health departments, schools, charitable institutions, welfare organizations, public spirited physicians, and newspapers; if enough followers will support these leaders in the work, the problem will be on the way to solution. Children of preschool age are the hardest to reach, as the older ones are in touch with the school system.

All children have the right to a fair start in life; those who do not get it at home can look only to the community, whose future strength will depend largely on the start now being given them. Yet, there are many people who do not even realize that such a public problem exists. When a new problem is brought to their attention, they do not take the trouble to comprehend it. Comprehension of others' needs and some concern over them is the only sound basis for a public health interest.

Advance of the Health Movement.—The instances cited of indifference to public health measures are impediments, but fortunately are not dominating ones. The health picture as a whole gives no occasion for pessimism. Enormous strides have been made in the saving of life. Some diseases have been eradicated from communities where they had flourished, and others take but a fraction of the lives that they formerly did.

Diseases of such nature as to yield to known hygienic measures are causing smaller and smaller proportions of the death list, as the years go by. Infant mortality and the mortality from infectious diseases of childhood, from malaria, from yellow fever, from typhoid fever, from tuberculosis, from smallpox, and from other preventable diseases, have steadily decreased. More of the people live on until they die of the diseases of advanced age, or of other conditions which public health measures cannot as yet affect. In twenty years the proportion of deaths in America attributed to tuberculosis, typhoid fever, diphtheria, and infants' diarrhea,
for instance (A in Fig. 20) was cut down more than one-third; that attributed to apoplexy, organic heart disease, nephritis, and cancer (B in Fig. 20) rose correspondingly. The death-rate of early life has been dropping, and the average span of life thereby lengthened.

Fig. 20.—Preventable compared with non-preventable disease.

The health movement quite clearly has prolonged lives and added to the health and happiness of life. As its scope widens there will be still fewer discomforts, and fewer deaths except from diseases of old age. Its goal has been expressed as the prevention of all preventable diseases. This goal is still a distant one, but as the average person becomes more interested and enlightened in health values it will be the more rapidly approached.

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