

OSTEOPATHIC SURGERY,  
—ITS—  
PRINCIPLES AND PRACTICE.

PART I.

GENERAL PATHOLOGY AND SURGICAL DISEASES.

INFLAMMATION.

**Definition.**—Inflammation may be defined as the reaction of the tissues to an actual or referred injury, providing that injury is not so great as to produce death. Contrary to what was formerly believed, inflammation is essentially a reparative process, instead of a disease producing entity. It is a disease process which varies according to the nature of the injury and condition and character of the tissues. It has been defined as “nature’s effort at the process of repair.”

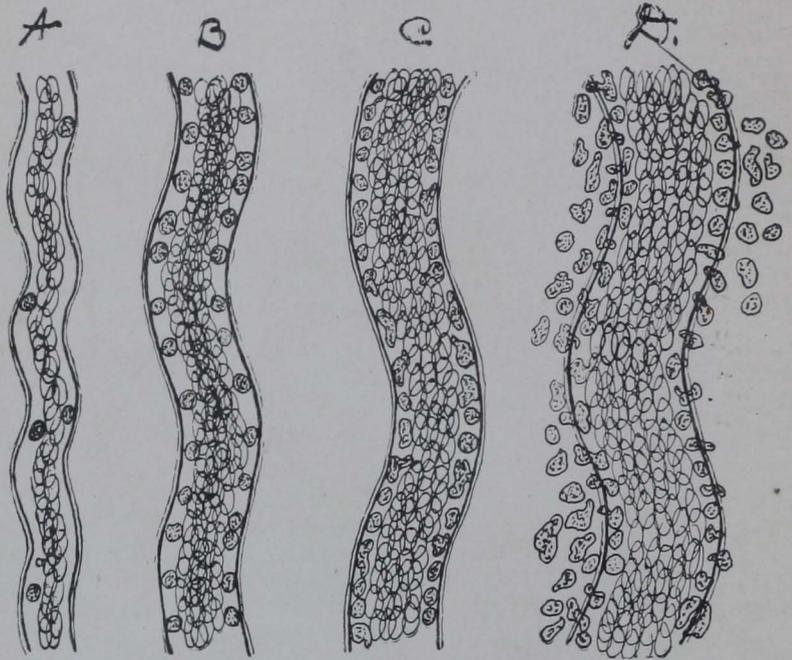
**Pathology.**

The changes taking place in inflammation may be grouped in the following manner:—Vascular and circulatory changes. (2) Exudation of fluids and the migration of leukocytes through the blood vessels, and (3) Changes in the perivascular tissues.

**Vascular and Circulatory Changes.**—When an irritant is applied to a vascular area, a momentary contraction of the blood vessels may or may not occur, but this is quickly followed by a dilatation of the capillaries, arterioles, and venules. The blood flows more swiftly to the injured area, hence we have “determination of the blood to the part.” This engorgement with flowing blood is called active hyperemia, or congestion. If the blood current be slowed and the engorgement still continues, it is then termed passive congestion. This is usually due to some obstruction to the return circulation, perhaps, also, to a lack of tonicity to the vessel walls, or to a weak heart. But the active hyperemia continues and perhaps pulsation may occur in the venules and other smaller vessels. Capillaries previously invisible become highly distended. During this stage no exudation of fluid takes place. If the irritant be removed the blood vessels promptly return to their normal size and all evidences of hyperemia disappear. This is what often occurs in hives. If the irritation continues, certain changes will occur in the blood; white corpuscles will become separated from the

general blood stream and will align themselves along the vessel wall, the red corpuscles still continuing in the centre of the stream. Presently it will be noticed that the leukocyte finds an opening (stoma) in the vessel wall, through which it succeeds in escaping (diapedesis). In violent inflammation numbers of the red corpuscles may also escape at the same time (rhexis). It must be remembered that the leukocyte

FIG. 1.



Inflammatory changes in a small vessel: *a*, normal circulation; *b*, dilatation; *c*, leucocytosis; *d*, migration of the leucocytes.

is an ameboid cell, which explains its ability to escape through the stomata in the vessel wall, which act, it readily and quickly accomplishes—variously estimated by different observers at from one-half to one and one-half hours. But during this time the blood current is slowed perceptibly until finally it actually stops (stasis), then the liquid elements of the blood pour out through and between the cells in the vessel wall, while the leukocytes swarm out in vast numbers, the number depending largely upon the severity of the inflammation. Migration of the leukocytes to the inflamed area next occurs. It is believed that the leukocytes are attracted by certain chemical substances (positive chemotaxis). It is also believed that they are repelled by other substances (negative chemotaxis). Certain it is that they are attracted to the inflamed area from the blood vessels from whence they come.

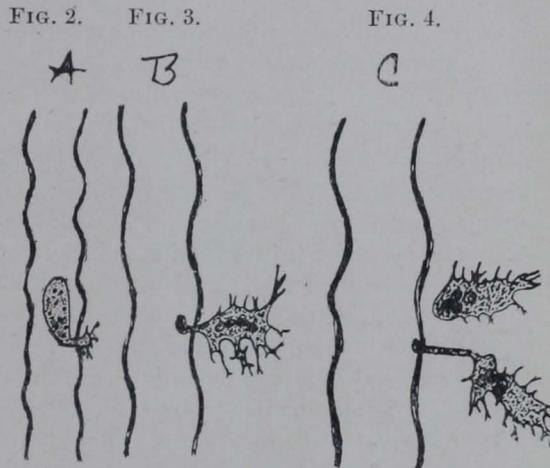
**Phagocytosis.**—It is known also that the leukocyte has the power to eat up, as it were, certain offending materials, such as portions of dead

cells or effete materials, but more important than all, bacteria which may have gained entrance into the body. The white corpuscle is able to destroy the bacteria by means of certain chemical compounds which it contains (phagocytosis), and it is also believed that certain connective-tissue cells and endothelial cells also have the same phagocytic properties, but to a

less degree. If the inflammation is very severe the exudation of the fluids into the tissues may occasion great swelling. The blood vessels are greatly distended and, if the stasis is complete and extends to the arterioles, oscillation will take place in the blood stream, occasioning a throbbing sensation to the patient. Redness will be marked, and in severe inflammations where red

corpuscles escape from the vessels, the area will be of a dark bluish color. The skin is often stretched to the utmost where the affection is superficial, presenting a shiny appearance. Considerable local heat is manifest.

**Changes in the Perivascular Tissues.**—In addition to the exudation of the fluids and the migration of the leukocytes, there are other important changes in the tissues. Rapid proliferation of the resident connective-tissue cells takes place; these cells, with the assistance of the leukocytes, form more or less of a wall or barrier around the source of inflammation, or irritant, as if to prevent it spreading or extending to other tissues. These new cells are embryonal in character, but if the irritation continues some length of time they will become differentiated into other forms, chiefly fibrous tissue, and then if the irritation should be removed without the destruction of any cells, the part would perhaps be permanently altered by the formation of this new tissue. Where any tissue is destroyed, as in case of abscess formation, ulceration, or wounds, these proliferated resident tissue cells take the place of the destroyed tissue and will always remain as an evidence of the inflammation. In open wounds it constitutes the scar tissue or cicatrix. The changes taking place in the tissues depend largely upon the nature and cause of the inflammation.



A, B and C illustrating the various stages of diapedesis and migration of the leucocyte.

### Causes of Inflammation.

(A) Predisposing and (B) Exciting.

**Predisposing Causes.**—(1) Abnormal blood supply; abnormal in quantity as in obstruction to arterial, venous, or lymphatic circulation by bony lesions, contractions of fascia or muscles, or because of insufficient food, lack of fresh air, hemorrhage, anemia, etc. Abnormal in quality because of certain poisons circulating in the blood as occurs in chronic alcoholism, Bright's disease, diabetes, gout, syphilis, lead, mercury and phosphorus poisoning, etc.

(2) Abnormal nerve influence because of pressure on the nerve or disease of the nerve trunk supplying the part affected.

**Exciting Causes.**—These may be best considered as (1) chemical and (2) mechanical. By mechanical cause is meant any trauma, as a bruise, cut or other injury. The chemical causes consist of irritating chemical compounds and micro-organisms. These irritating chemical compounds consist of caustic alkalis and acids and toxic animal and vegetable substances. Micro-organisms cause irritation by means of certain chemical compounds which they produce either by the metabolism of their own bodies or by their action upon the tissue cells. It is a recognized fact that some of the most toxic substances known are produced by bacteria, further, that micro-organisms are perhaps the most important factor in the majority of inflammations, being always present, the injured cells give them an opportunity of entering the tissues, when inflammation will result. In the treatment of inflammation this cause should always be kept in mind.

### Terminations of Inflammation.

Inflammation terminates in (1) resolution, (2) new formation, (3) ulceration and abscess formation, and (4) necrosis.

**Resolution.**—By resolution is meant that when the cause of the morbid process is removed or ceases, the tissues return to the normal condition.

**New Formation.**—This consists of inflammatory tissues, the result of proliferation of the resident connective-tissue cells; especially is this true of inflamed joints where injury, attended by long continued irritation brought about by efforts to use the member, results in the formation of fibrous tissue about the joint, binding down the tendons and ligaments, destroying bursae, lessening the range of motion, whilst terminal nerves are compressed, which results in more or less constant pain. Wherever injury or disease destroys any tissue, the tissue taking the place of that destroyed consists of regenerated nerves, muscles or other tissues as the case may be. Tissue the result of proliferation and development of the connective tissue cells is called a scar or cicatrix.

For other terminations of inflammation see Ulceration and Abscess Formation and Necrosis.

### Varieties of Inflammation.

The varieties of inflammation are *acute*, when the tissue changes are active, and *chronic*, when the tissue changes are slow and the cause is long standing.

**Chronic Inflammation.**—The causes of chronic inflammation, are, as in acute inflammation, local and constitutional, but there is more frequently some constitutional cause operating. The color usually indicates venous congestion due to continued dilatation of the veins from obstruction of the return circulation. The pain, which is less severe than in acute inflammation, is usually of a dull, aching character, is more or less constant and is often severest at night. Swelling is often one of the most pronounced of the symptoms. The increased heat is often not perceptible when the inflammation is on the surface of the body. When an important organ is affected a slight rise of temperature may occur. The changes taking place in chronic inflammation are the same as those which occur in acute, except they are less rapid.

Other forms of inflammation are *traumatic*, that which is due to injury; *infective* or *specific* when produced by specific micro-organisms; *sthenic* when happening in full blooded people; *asthenic* when occurring in the old or debilitated; *parenchymatous* when affecting the parenchyma of an organ; *interstitial* when it involves the connective tissue of an organ; *serous* when accompanied by a serous exudate; *purulent* when attended by the formation of pus; *fibrinous* when the exudate is coagulable; *hemorrhagic* when the exudate contains red blood cells; *croupous* when a membrane forms over the inflamed area; *diphtheritic* when the membrane formed resembles that in diphtheria; *gangrenous* when the inflammation is accompanied by death of a mass of tissue; *simple* when due to no specific cause; *catarrhal* when it affects mucous membranes; *idiopathic*, a term formerly used to indicate an inflammation without a cause; *neuropathic* when there is an impairment of the trophic nerves to the part; *sympathetic* when inflammation takes place in one part because of an irritation in another part, as sometimes happens in the eye.

### Signs and Symptoms.

The symptoms of inflammation are (1) pain, (2) heat, (3) redness, (4) swelling, (5) interference in function.

**Pain** is due to pressure upon the peripheral sensory nerves of the part.

**Heat** is produced by local irritation and by the circulation of certain products in the body which disturb the heat producing and heat regulating mechanism.

**Redness** may vary from a bright red, in acute inflammation, to a dark blue, in chronic inflammation, or in abscess formation to a dusky or very dark bluish color.

**Swelling.**—This varies with the part involved. In some loose cellular tissues the swelling may be very great. In the inflammation of bone little swelling may be evident, yet the pain may be extremely severe.

**Interference in Function** will largely depend upon the part involved, the severity of the inflammation and the violence of the other symptoms. As a general rule the severity of the symptoms varies with the violence of the inflammation.

### Treatment of Inflammation.

(A) Osteopathic measures, and (B) Other measures.

**Osteopathic Measures.**—The results of inflammation depend largely upon the freedom of the circulating fluids and their quantity and quality. Degenerations, ulcerations, and necrosis are the result of impaired nutrition or its sudden arrest, therefore it should be the first duty of the physician to remove any obstruction to the lymphatic or venous circulation so as to prevent congestion, or any obstruction to the arterial circulation so that the tissues may receive their proper quota of fresh blood. Unless stasis occurs, destructive changes will not happen, hence it is of the utmost importance to prevent a stopping of the circulation. This may be done by encouraging the circulation through the agency of the vasomotor system. Furthermore, the metabolism and the tissue changes may be directly influenced by relieving the pressure on a nerve to a part, or reflexly by stimulating or inhibiting them as may be required. Bacteria constitute the most important factor in inflammation. Years ago Dr. A. T. Still contended that the most efficient germicide within the body was a free flow of fresh blood; this is now generally admitted. It is a recognized fact that under all circumstances nature heals the sore if given a chance. No salve, medicine, or other application has such properties. No chemical reagent will destroy the germs without destroying tissue as well. Bacteria are only destroyed by nature's forces, therefore it is of the utmost importance that a good free flow of fresh blood should be secured. This can be done by removing any obstruction to the arterial flow or to the return circulation, either lymphatic or venous. An increased flow of fresh blood can best be secured by stimulating the vasomotor nerves to the part. Lesions affecting the inflamed area may be found in the planes of fascia, in contracted muscles, or in the partial displacement of bones.

**Other Measures.**—The local treatment of inflammation consists of (1) removing the irritant, (2) cleanliness and asepsis, (3) antiseptic, (4) rest, (5) elevation of the part, (6) cold, (7) heat, (8) incisions, and (9) manipulation.

**Removing the Irritant** consists, in case of wounds, in searching for foreign bodies or the removal of any noxious chemical product.

**Cleanliness and Asepsis.**—Asepsis means not only that the part be apparently clean, but that it be surgically clean, which means that it

must be germ free. This can best be obtained by the methods detailed under "Asepsis."

**Antisepsis** in inflammation consists in using those agents which inhibit the growth of, or destroy, the micro-organisms which play such an important part in inflammation; this, however, is but another means of removing the cause of inflammation. The kind of antiseptics used and the method of their application is given elsewhere.

**Rest** must be both functional and physiological; it may be obtained by position or by immobilizing a joint. Physiological rest, in case of ulcer of the stomach, can best be obtained by fasting for a time.

**Elevation of the Part** is of great importance in inflammation of the lower extremity. Here elevation assists return circulation and secures a better blood supply to the inflamed area, which is of the greatest importance in chronic inflammation or in old ulcerations or varicose ulcers of the leg or foot.

**Cold** is of the greatest value in the early stages of inflammation and is best applied by means of an ice-pack or cold water coil; intense cold should be used. It is especially serviceable in sprains.

**Heat** applied early in inflammation is said to cause dilatation of the arterioles and to assist the circulation. In the later stages it hastens and localizes pus formation. It is best applied in the form of hot stupes, hot fomentations, hot water bags, poultices, and dry heat. Hot stupes may be applied by rinsing flannel, doubled so as to make three or four thicknesses, in boiling water. That this may be done without scalding the hands, a strip of flannel six inches wide and two feet long, the two ends being sewed together, is necessary. Now with two sticks about a foot long, this flannel may be dipped into the boiling water, when the sticks may be quickly twisted and the flannel thoroughly wrung out. While the flannel is very hot a few drops of turpentine may be dropped on the cloth, when a turpentine stupe is made. This is very effective in deep seated inflammations and where there is not a broken surface. The turpentine is an active antiseptic but is too irritating to be used on an open wound. Hot cloths may be wrung from a boiling saturated solution of boracic acid and placed over the inflamed area, when, in addition to heat, antisepsis is also secured. In the application of these hot stupes or fomentations, sheet-rubber should be applied over the hot cloths until they are changed, which should be every five or ten minutes to be effective. A poultice may be made of ground flaxseed, elm bark, starch, bread and milk, potatoes, etc. To make a flax-seed poultice, stir the ground flax-seed in a basin with a little boiling water; keep adding the flax-seed and stir constantly until it is of the consistency of thick mush. It can now be spread upon a piece of aseptic or antiseptic gauze, which can be doubled over the poultice to prevent its sticking to the surface of the body. It may then be applied to the inflamed area with a piece of sheet-rubber or oil-silk covering to retain the heat. The function of the poultice being heat and moisture, as soon as the heat has dis-

appeared a new poultice should be applied, which will be from every quarter to a half hour. In violent and very painful inflammations a sedative poultice is of value. This can be made by adding from ten to twenty drops of laudanum to the poultice—being well stirred in previous to spreading on the cloth. An anti-septic poultice may be made by rinsing several thicknesses of gauze in a saturated boric acid solution and applying to the inflamed area, placing over it oiled silk or sheet rubber, and then applying a hot water bag; by this means heat and antiseptics are likewise obtained. Dry heat may be applied in the form of hot water bag or hot sand bag, which is often times of service in deep seated inflammations, as of joints. When suppuration is imminent the application of heat gives great relief and should be applied until pus formation is evident, then a free incision should be made, the pus discharged and rigid antiseptics maintained.

**Incisions** are sometimes useful to relieve congestion in the case of tonsillitis and edema of the glottis.

**General Treatment.**—The old idea in the treatment of inflammation was diet, drugs, and blood letting. The drugs used were diuretics, diaphoretics, purgatives, emetics, anodynes, and other remedies, such as aconite, quinine, salicylic acid, mercury, etc. These have been eliminated and are no longer necessary. Phlebotomy and leeching are relics of the days of barber surgery. In the general treatment of inflammation diet, attention to the secretions, and the relief of the various symptoms arising are of importance. In severe inflammation the diet should be restricted to milk, gruel, soup, beef-tea, barley water, toast, and other easily digested foods. The urinary secretions should be kept free, the bowels open, and the liver acting. The secretions of the mouth should not be allowed to become foul. In severe cases of erysipelas and typhoid fever the mouth should be rinsed with Listerine or boric acid solution to prevent sordes forming on the teeth. The secretions of the skin should be kept active by baths. Symptoms arising may easily be combated; pain, the chief symptom, is an evidence of pressure on the nerve; by manipulation this pressure may be removed. In the treatment of chronic inflammation it is very essential to determine whether or not there are any constitutional causes operating, whether it is because of vicious habits of the individual or because he lives in unhealthy surroundings. Whatever the cause is, this should be corrected, the mode of life changed, the person should be well nourished, and the inflamed area protected from further irritation. Recovery from an old inflammation oftentimes takes place slowly and many times the prognosis is unfavorable.

## SURGICAL BACTERIA.

**Definition**—A bacterium is a minute, one-celled vegetable organism. They belong to the class of moulds or fungi. Fungi may conveniently be divided into three classes:

1. Saccharomycetes, or yeast fungi.

2. Hyphomycetes, or moulds.

3. Schizomycetes, fission fungi, or bacteria.

Of these three classes of fungi the last is of the greatest importance to the physician, inasmuch as many of them produce disease, while not many of the moulds or yeast fungi are harmful.

### Morphology of Bacteria.

Bacteria may be divided into three general classes—cocci, bacilli, and spirilla. Cocci are spherical shaped organisms and may, or may not have flagella. Flagella are small hair-like processes which project out from the bodies of the bacteria and furnish them means by which they may move. They are similar to the cilia upon ciliated epithelial cells. Bacilli are rod shaped organisms which may be joined end on end, forming a delicate thread called leptothrix. Spirilla are spiral shaped organisms, which, when joined end to end and showing no evidence of division are called spirochetæ. Cocci vary in size from .15 to 2.8 mikrons. Bacilli vary from .2 by 1 mikron to 1.5 by 5 mikrons, while some of the spirilla may be as long as 40 mikrons. The weight of a bacterium has been estimated by Nageli to be 1-10,000,000,000 of a milligram.

### Motion.

As before mentioned, some of the bacteria are capable of motion (motile), while others are not (non-motile), while some have flagella and others have not. In some cases bacteria may be capable of exceedingly rapid motion, while others move more slowly and are less active.

### Reproduction.

Bacteria are capable of reproducing themselves by at least three different ways; by fission, endospores, and arthrospores. It has been estimated by Buchner that under favorable circumstances a bacterium can reproduce itself in from fifteen to forty minutes. At this rate he estimates that it would be possible for one bacterium, under favorable circumstances, to be the origin of sixteen million in twenty-four hours. It has been estimated that if bacteria were supplied with a sufficient amount of food, within three days one would develop a mass weighing 4752 tons; but fortunately the conditions are rarely present for such appallingly rapid reproduction. This likely accounts for the fact that bacteria produce disease less often than might be expected, also that many times when conditions are favorable it likely accounts for the rapidity of the course which the disease runs.

Bacteria group themselves in many different ways. Diplococci are cocci existing in pairs, as the diplococcus lanceolatus; or the diplococcus Neisseri. Tetrads are cocci grouped in fours, as happens with the micro-

coccus tetragenus. Sarcina is where the bacteria increase in all directions alike and where they present the formation of groups or blocks. Streptococci is where the bacteria exist in chains, which may be short or long. Staphylococci is where the bacteria form an irregular group or mass. Leptothrix is a condition where the bacilli form in long chains and where the division between the individual bacilli can not be readily made out. Spirochetæ is where the spirilla form in long spiral-like threads. These are the commonest forms of bacteria. For a more extensive description, works on Bacteriology should be consulted.

#### Distribution in Nature.

**Air.**—Bacteria are found almost everywhere in nature, in the dust of the air, in water and in the soil. In 1686 Francesco Redi proved that maggots arising in putrid meat did not arise *de novo*, but that they came from the flies buzzing around the meat and frequently alighting thereon. It has been proven that fermentation, wherever found, comes from bacteria which may have gotten into the fermenting substance or liquid. Bacteria exist almost everywhere in nature except perhaps in mid-sea or at very high altitudes. John Tyndall proved that practically no bacteria were found at high Alpine altitudes. He furthermore proved that the bacteria causing decomposition very often come from the dust particles in the atmosphere. He proved that meat lying in a dust-proof chamber would keep for a long time, while that exposed to the dust particles of the air would quickly decompose. By experiment it has been shown that there are from 100 to 1000 bacteria of various kinds to each cubic meter of air. In crowded houses and in cities this number would be much greater, whereas in rural districts it likely is much smaller.

**Water.**—Bacteria are found extensively in all water, especially is it true of infected river water. In good pump water the number varies from 100 to 200 per cubic centimeter; in unfiltered river water from 6,000 to 20,000 per cubic centimeter. Contrary to what is popularly believed bacteria may frequently live in ice. Prudden proved that the average Hudson river ice contained 398 micro-organisms per cubic centimeter.

**Soil.**—It has been estimated that virgin soil contains 100,000 germs per cubic centimeter. These germs exist only in the upper strata of the soil, perhaps in the first two feet only, except where water containing a considerable amount of decomposing animal or vegetable matter is percolating through the ground, at which place the bacteria may be found at a depth of several feet. It would seem from these statements that one might be readily infected with disease germs, but it must be remembered that for the most part these germs are harmless saprophytes and will not produce disease. It is only when water or soil becomes infected with disease producing germs that infection spreads.

**Human Body.**—It is a known fact that about human habitations and about the animal body bacteria exist in large numbers, apparently living on the effete material or the excreta. They are found in the secretions of the mucous membranes, in the various mucous membranes and in the superficial layers of the surface epithelium. On the parts of the body covered with hair and in the flexures they are found in very large numbers, hence wounds in these regions are much more liable to infection. One thing is certain, that the fluids of the body are free from bacteria under normal conditions, and when bacteria are found in the body-juices it is an evidence of disease. In the salivary secretions large numbers of bacteria are found, likewise in the lachrymal secretions. Large numbers of bacteria are constantly being taken into the respiratory tract, lodging in the crypts of the tonsils and in the crevices of the pharynx, hence this cavity is teeming with them. Many of them are carried on into the stomach, escaping the gastric secretion they thrive in the intestines, so the contents of the intestines are exceedingly septic. Bacteria are not generally found in the urine within the bladder, but in diseased conditions they frequently get into the urine in large numbers.

#### Conditions Affecting Growth.

**Oxygen.**—Some bacteria live best without oxygen; these are called anaerobic; others grow best in oxygen; these are called aerobic. Some bacteria grow best without oxygen but can grow with it; these are called facultative aerobics; likewise some of those growing in oxygen may thrive without oxygen; these are called facultative anaerobic germs.

**Nutrient.**—Bacteria are not able to derive their nourishment from purely inorganic matter, but live for the most part, it seems, on highly organized compounds. They seem to grow best where diffuse albumins are present.

**Moisture.**—A certain amount of water is always necessary for the growth of bacteria, as with any other form of vegetable life; however, this does not mean that drying will destroy them, for bacteria may live upon clothing apparently dry, in some cases for some months, and if the clothing be damp, even a longer time. Bacteria may also be wafted great distances in a dried condition by means of dust particles in the atmosphere and they may live in this condition a considerable length of time.

**Reaction.**—The pabulum upon which bacteria thrive, to be most suitable for their growth, should be faintly alkaline or faintly acid; strong alkalis or strong acids destroy bacteria.

**Light.**—Most species of bacteria are not influenced to a great extent, in their growth, by the presence or absence of light; however, many of the bacteria will grow best in a dark room, while there are others whose growth seems to be retarded by the direct rays of the sun's light. Some colors, especially blue, are prejudicial to their growth.

**Movement.**—A condition of perfect rest seems to be most favorable for the development of bacteria. Movement of the culture medium, as sudden agitation, if kept up, will destroy the bacterial growth. It is this agency acting which seems to be one of the greatest sources of destruction of bacteria, and flowing water, especially falls and rapidly flowing streams, are peculiarly free from bacteria. Other things being equal, the water from such streams should be best for drinking purposes.

**Association.**—Very often in disease processes of the body several forms of bacteria are associated and it is not unusual that this association makes one or the other of the bacteria more virulent and active. Still it is known that in some cases one infection will, to some extent, render the individual more or less immune to the onslaughts of certain other bacteria.

**Temperature.**—Frankel states that bacteria grow best between the temperatures of 16 and 40 degrees C. Many bacteria will flourish in a higher temperature than 40 degrees C., many will flourish fairly well in a temperature lower than 16 degrees C. A temperature from 30 to 75 degrees C. (108 to 135 degrees F.) if continued for some length of time will arrest the growth of most bacteria. Boiling for a few minutes will entirely destroy nearly all bacteria. This is of the utmost importance to the physician, as it furnishes him a harmless method by which he may secure asepsis.

### Results of Vital Activity.

**1. Fermentation.**—The various forms of fermentation, wherever found, are generally due to the development of bacteria. Some of these bacteria may be harmless, while many times they may be exceedingly poisonous.

**2. Putrefaction.**—The term putrefaction differs from fermentation, in that it especially refers to the fermentative process taking place in nitrogenous bodies. The manner in which this takes place seems to be that the albumins are converted into peptones and these are split up into gases, acids, bases, and salts. It is in this reaction that many times some of the most virulent poisons are produced. Ptomain, for instance, are the result of putrefactive changes taking place in organic matter, either animal or vegetable. According to Vaughan and Novy, ice-cream, meat, and cheese poisoning are really ptomain poisoning, the ptomain having been produced by putrefactive changes in the food products.

**3. Gases.**—It is not unusual for the bacteria to produce noxious gases. Many times this gas production gives rise to offensive odors. This is oftentimes seen in foul and infected wounds where the secretions are teeming with bacteria.

**4. Enzymes.**—That bacteria produce enzymes, or ferments, is well known and it is also known that many times these enzymes or ferments are exceedingly poisonous. Whether they result from the secretion of the bacteria themselves, or the action of the bacteria upon other matter, is not certainly known. These poisons are sometimes extremely virulent, as for instance, the purified toxin, tetanin, of the tetanus germ was found by Brieger and Cohn to be fatal to mice in doses of 0.00000005 gram. Lambert holds that this is the most poisonous substance ever discovered. It is to these enzymes that bacteria owe their ability to produce disease.

**5. Disease.**—Bacteria are divided into two general classes, *pathogenic*, those capable of producing disease, and *non-pathogenic*, those not capable of producing disease. It is believed that their ability to produce disease depends very largely upon whether the substances produced by the bacteria are poisonous. These poisonous substances, as before stated, are either the result of the secretion of the bacterium itself, or the result of the action of the germ upon the body cell.

### Infection.

Ziegler defines infection as "The entrance of bacteria into the body and their increase there." This means, of course, the multiplication of the bacteria within the tissues. Certain conditions are necessary before infection can take place; these are now generally admitted by most authors to be:

1. The bacteria must be present in sufficient numbers.
2. There must be an avenue of entrance into the tissues.
3. There must be a diminished resistance of the tissues.

There are other conditions, however, which modify infection:—These are the virulence of the germ and immunity of the subject. It is known that germs vary in virulence, some species of a certain germ may be extremely virulent and active, while others may scarcely produce evidence of disease. The infected subject may be to some extent immune to the organism in question. These conditions will modify the development of the bacteria within the tissues. This likely explains why infection occurs in some cases and not in others.

### Avenues of Infection.

**Skin.**—Inasmuch as bacteria are found in large numbers upon the surface of the body, wounds are very liable to become infected; and as the bacteria are much more numerous in the hair, in the sweat glands, in the sebaceous glands, and in the roots of the hair, on parts of the body where these structures are found, infection is much more likely to happen.

**Mucous Membranes.**—Abscess of the tonsil likely arises from bacteria taken in through the air or by means of food or drink and lodging

in the crypts of the tonsil. The secretions of the mouth cavity are septic and it is essential in wounds of the mouth that measures be taken to cleanse the cavity. The lower bowel contains immense numbers of bacteria and in constipated conditions poisons of these germs are not infrequently absorbed; furthermore, were it not for the resisting power of the tissues, wounds of the lower bowel would always result in infection. It seems to be true that it is this resisting power of the tissues which protects the individual from infection, for often it is that every individual has sustained small wounds, either on the surface of the body or in some of the cavities of the body, when bacteria were undoubtedly present in large numbers, yet infection did not take place. This can readily be explained by the fact that the tissues prevented the entrance and multiplication of the bacteria.

#### Characteristics of Infection.

According to McFarland these are (1) phlogistic, (2) toxic, and (3) septic.

By phlogistic is meant an inflammatory reaction. The toxic effects consist of local growth with absorption of toxins. The septic effects are those characterized by the dissemination of the bacteria through the lymphatic fluids and the blood. In most instances the actual damage done by these germs and the poisonous effects produced are due to the ferments developed by the germ.

#### Toxins.

Bacteriologists seem not to be able as yet to classify the poisons generated by bacteria. They are likely all proteid substances, most of which probably belong to the class of substances called toxalbumins. The poisons of diphtheria and tetanus seem to belong to a class by themselves, inasmuch as they give no albumin reactions. As a general rule the poisons are highly organized and are readily destroyed by temperatures above 108 degrees F., also exposure to air and sunlight seem to readily destroy them. Some of the substances seem to be alkaloidal in nature and are readily soluble and quickly diffuse through the body. It is believed that this explains why some diseases run such a very rapid course and are so alarmingly fatal, since the poisons are readily soluble and are quickly diffused through an animal membrane and are carried through the body before the germ has actually entered the tissues.

#### Ptomains.

Many writers include ptomains under toxins. They are best considered as putrefactive alkaloids and are the result of the decomposition or breaking up of organic substances, in contradistinction to the decomposition or breaking up of organic substances, especially by bacterial action.

### Leucomains.

Leucomains are alkaloidal substances existing normally in the body and which arise from retrograde metamorphosis or chemical changes in the cells. It is not unusual that these substances may be retained in the body and not eliminated, when auto-intoxication occurs. Certain substances found in the urine belong to this class, as xanthin and hypoxanthin. There are substances which exist normally in the bowel, but which under certain circumstances are absorbed and which will produce febrile, circulatory, and other disturbances.

### Antitoxins.

The exact nature of antitoxin is unknown. Some maintain that it is a toxin in a changed form, others that it is a ferment produced by culture, and still others that it is produced by cellular activity. This last idea seems to have the most foundation in fact. Whatever is the nature of antitoxin, it is obvious that after the system has gotten rid of a certain infection it is not in the same condition that it was previous to the infection; that many times it is left more or less immune, for varying periods of time, to subsequent infections. It is believed by some that this resisting power of the body is contained largely in the blood and that the resisting power of the blood is due largely to the chemical changes which have taken place in the leukocytes. It is known that the antiseptic property of the blood from immune individuals is much greater with reference to the bacteria in question, than the blood from an individual not having such immunity.

### Forms of Bacteria.

The forms of bacteria in which the surgeon perhaps is most interested are the following:

**Staphylococcus Pyogenes Albus.**—Passet found this germ in pure culture in four cases of suppuration out of thirty-three examined.

**Staphylococcus Pyogenes Aureus.**—This is the most common of the pus germs and is nearly always present in the pus of boils and furuncles.

**Streptococcus Pyogenes.**—According to Rosenbach this germ is present in eighteen out of thirty-three cases of suppuration. The pus produced is usually thin, white, and flocculent. It produces diffuse pus formation and its activity is much greater than the other pus germs.

**Streptococcus Erysipelatis** or Fehleisen's germ seems to be identical with the streptococcus pyogenes of Rosenbach. It often produces pus and can be obtained in pure culture from serum which oozes from a puncture made at the margin of an erysipelatous area.

**Bacillus Pyocyaneus** is the germ of blue or green pus; it likewise produces disagreeable odors. It is rarely found in pure culture in pus, but is generally associated with other germs.

**Micrococcus Gonorrhoea** (Neisser), when inoculated in any mucous membrane produces a characteristic ulcerative process, attended with pus formation.

Other germs which are associated with pus formation, but less frequently, are *Diplococcus intracellularis meningitidis*, *Diplococcus pneumoniae*, *B. Tuberculosis*, *Leprous Bacillus*, *Streptothrix Actinomycosis*, *B. tetanus*, *B. diphtheriae*, *Micrococcus tetragenus*, *B. anthracis*, *B. typhi abdominalis*, *B. coli communis*, *B. pestis bubonicae*, and *B. mallei*.

### ANTISEPTICS.

An *antiseptic* is an agent which retards or inhibits the growth and development of bacteria. A *germicide* or *disinfectant* is an agent which destroys bacteria. A *deodorant* is an agent which destroys offensive odors, but which may not be a very active antiseptic. Chemical antiseptics are soluble substances which retard or inhibit the growth, or in some cases destroy the activity, of micro-organisms. It is easy to develop an antiseptic which will destroy bacteria in a test tube in the laboratory, but unfortunately it is not so easy to secure an antiseptic which will not be harmful to the tissues with which it comes in contact. Our best antiseptics are most destructive to the tissues. Perhaps the best of all known chemical antiseptics for practical use are bichloride of mercury and carbolic acid. These substances are well known active poisons and can be used only with certain limitations and under certain circumstances. The ideal antiseptic is yet to be devised. The most powerful of these antiseptics is corrosive sublimate and it is perhaps the most reliable. It is used in the strength of from 1:500 (in exceptional cases) or 1:1000 to 1:10,000 or 1:20,000 parts of distilled water. It can not be used in metallic vessels, nor can it be used to disinfect instruments. It is irritating to wounds and often causes copious exudation and in this way does harm. It is perhaps most useful as a disinfectant for the hands or the surface of the body or certain articles of clothing. When used on the various parts of the body these rules must be observed. In the eye it is used in the strength of 1:10,000; in the mouth and throat, never. In the vagina and uterus in strengths of 1:1000 to 1:5000, depending upon the requirements. In abscess cavities it may be used where there is free drainage, but under no circumstances must it be used where it is likely to be retained. In joints it may be used in strengths of 1:5000 or 1:10,000. It should not be used in the ear, nose, urinary tract, bowel, or the peritoneal cavity. In spite of its draw-backs, bichloride of mercury is generally considered to be the best of the antiseptics. It is prepared in two forms, a small tablet containing 1.41-50 grains, which when dissolved in a pint of water makes 1:4000 solution or in a larger sized tablet containing 7.5 grains, which when dissolved in a pint of water makes a solution of 1:1000. These tablets also contain muriate of ammonia, which hastens their solubility.

**Carbolic Acid** is very valuable as a germicide in strengths varying from 1:20 to 1:100. It has the advantage that it will not attack metal, hence the antiseptic solution can be made in any sort of an aseptic vessel. It is readily absorbed and produces toxic symptoms, hence it must not be used in cavities of the body where absorption may take place. Neither can it be used in the mouth or throat where it is liable to be swallowed, nor in the bowel, inasmuch as rapid absorption might take place with collapse and death. It is best used in a liquid form. Liquid carbolic acid is prepared by heating the crystals and adding five per cent. of water. For practical purposes a teaspoonful of the liquid drug added to a tin cup of boiling water makes a serviceable antiseptic solution. If a more active solution is desired, two teaspoonfuls of the drug should be added to the pint of water. It is irritating in wounds, and likewise has marked anesthetic properties, often attacking the surgeon's hands to the extent that it will materially interfere with an operation. It may be used in the mouth in the strength of one to two per cent. In tubercular abscesses and suppurating joints it may be used in a five per cent. solution. In the vagina and uterus it may be used in a two per cent. solution. It should not be used in an abscess cavity where it is likely to be retained. Pure, it is of great service in cauterizing chancroids and sloughing ulcers, also old abscess cavities or old infected ulcers. It is likewise serviceable as an antiseptic when incorporated with vaselin. It has the advantage in from 1 to 5 per cent. strengths with vaselin, that it is a good anesthetic and will often allay itching and irritation; especially is this true about a wound or open sore.

**Creolin** is an active antiseptic and is prepared from coal-tar. It has not the toxic effects of carbolic acid or bichloride of mercury and is also not irritating. It is used in strengths of from 1 to 5 per cent. as an emulsion.

**Peroxid of Hydrogen** has active oxidizing properties and is a serviceable cleansing agent. Some preparations are slightly irritating but are not toxic. It has the advantage that it can be used almost anywhere and in any location of the body, with the exception of an abscess cavity with a small opening. It oxidizes the dead material and detritus in the abscess cavity, so that if there is but a small opening from the cavity, the active production of gas will force dead materials into other parts of the tissues leading to the extension of the infection, whereas, if the abscess cavity has a free opening the application of the peroxid of hydrogen loosens up and gets rid of the dead material. It is useful with other antiseptics, for instance, a pus cavity may be washed out with peroxid of hydrogen and when cleansed of the dead material it may then be washed out with bichloride of mercury or carbolic acid, which are much more active antiseptics. Furthermore, its long continued use is prejudicial in many ways. It prevents wounds healing. It should not be used in bed-sores, except occasionally for cleansing purposes. If used regularly the bed-sores will refuse to heal. It should not be used in large abscesses on the neck, inasmuch as the formation

of gas might dissect through the connective tissue planes and press upon the air passages. It is used in the strengths found on the market, or diluted, one part of the solution to one, two, three or more parts of boiled water, as is required. It may be used in suppuration of the middle ear. In weak solutions it is useful for cleansing the throat and mouth and the nasal mucous membrane.

**Boracic Acid** is mildly antiseptic, and while irritating in a fresh wound, or a granulating sore, it is of great advantage in many cases. It is useful as a dry powder sprinkled over an ulcer, or as a saturated solution for syringing out cavities. It has the advantage that it is not toxic, no poisonous effects resulting from its use. In the eye it is used in the strength of ten grains to the ounce and is perhaps the best of all antiseptic solutions for such use. When it is very irritating there may be combined with it cocaine (two grains to the ounce). In abscess of the middle ear, a saturated solution is of service in a fountain syringe with an ear-nozzle, the stream being directed into the external meatus. It washes out the pus and destroys the micro-organisms. It is useful for washing out the bladder in cases of cystitis or purulent inflammation of the bladder. Here it is useful in a saturated solution.

**Permanganate of Potassium** is an active oxidizing agent. It is irritating and will stain the skin or tissues, but yet it is useful in the strength of 1:200 or 1:400 to 1:3000 or 1:4000 in distilled water for washing out foul ulcers or old abscesses and many times it acts with a happy result where other antiseptics apparently failed. It is useful as a disinfectant in stronger solutions in gangrene after the tissues have died.

**Nitrate of Silver**, introduced by Crede, is used in strengths of 1:300 to 1:1000. It is valuable in gonorrhoeal affections in the strength of 1:1000 and in from  $\frac{1}{2}$  to 1 grain to the ounce it is a valuable antiseptic in purulent inflammation of the eye, e. g., gonorrhoeal ophthalmia and old cases of trachoma. It is of advantage in from 10 to 30 per cent. solutions in cauterizing sores, mucous patches in the mouth, ulcers of the gums, or old ulcers of the leg which refuse to heal.

**Salicylic Acid** exists in the form of small, needle-shaped crystals which are slightly soluble in water. It is best used as a powder or as an ointment, being most useful as a dusting powder in wounds. It is useful in ointments in skin affections to allay itching. It is valuable as a deodorant and disinfectant in eczema of the feet.

**Iodoform** is a bright yellow powder and is extensively used in the treatment of wounds. Its offensive odor is the greatest objection to its use. It is a valuable powder in the treatment of fresh wounds; however, poisoning has followed in numerous cases. It is especially valuable in tubercular cases. It may be used as a dry powder or as a ten per cent. emulsion with glycerin. This may be injected into the abscess cavity or tubercular joint. Many substitutes for iodoform have been prepared. The best of these are iodol, salol, aristol, and dermatol. These

may be of advantage used as a dry powder on wounds. Aristol is odorless and non-poisonous and is valuable in various skin diseases. It is also useful in the treatment of sores in the form of an ointment (5 or 10 per cent.) or as a dusting powder.

### Ointments.

**Ichthyol Ointment** is a valuable antiseptic in inflammations, such as erysipelas, in strengths of 5 to 10 per cent.

**Boracic Acid Ointment** is an excellent preparation and is best prepared as three parts boracic acid, five parts vaselin, and ten parts paraffin, or, three parts boracic acid, four parts white wax, and twenty parts olive oil, or, a saturated solution of boracic acid and glycerin. These are excellent preparations as the case may require.

**Salicylic Acid Ointment** consists of one part salicylic acid, six parts white wax, twelve parts paraffin, and twelve parts olive oil.

**Protonuclein** is of advantage as a dusting powder in the treatment of ulcers.

**Formalin** is a valuable antiseptic and is useful for the disinfection of instruments and hands of the operator, but is too irritating and poisonous to be of use in wounds. It is used in strength of two per cent.

### Surgical Dressings.

Surgical dressings consist of gauze, cotton, lint, lamb's wool, or other substances which have the property of absorbing moisture or secretions from wounds or abscess cavities. Surgical dressings have the following objects in view: First, protection of the part from further infection; second, to absorb the secretions and keep the wound thoroughly dry to prevent further development of any noxious material which may be already present in the wound. Formerly, during the era of antiseptics, antiseptic gauzes were very popular and in most cases were very excellent dressings, but it is a recognized fact that many times these gauzes are irritating because of the chemical antiseptics and do harm rather than good. This has led to the production of aseptic dressings. Aseptic dressings are produced by superheating the article for some length of time at different periods until all germ life has been destroyed. Things prepared in this manner probably furnish the best surgical dressings in any form of fresh wound. Where the wound is septic and foul, antiseptic dressings are needed. In such conditions, bichloride gauze in the strength of 1:1000, carbolic acid 5 per cent., borated gauze 10 per cent., or iodoform gauze 10 per cent. may be used. These gauzes are prepared by impregnating aseptic cheese cloth with the drug. Cotton is a very useful article for the protection of a wound and for absorption of the secretions. Surgeon's absorbent cotton is the kind used. This is prepared by removing the oil from the cotton, after which it is asepticized, and is then ready for use. Surgeon's aseptic or antiseptic lint is useful in many cases.

**ANTISEPTIC PROPERTIES OF THE BLOOD.**

Different theories are advocated concerning the methods by which the human blood resists infection. Metschnikoff advocated the theory of phagocytosis. This has recently been attacked and quite seriously. Some have maintained that the leukocytes do not have the power of destroying bacteria, but in all probability they possess such power. The antiseptic properties of the blood do not come entirely from the leukocytes but come largely from substances imparted to the blood by means of the red marrow of the bones, adenoid tissues generally, and fibroblasts, and perhaps the tissues of certain glands. These tissue cells, when the occasion demands, produce certain substances named by Henkin as "defensive proteids" and these impart to the blood its antiseptic properties. Therefore, in the reaction of the tissues to injury the antiseptic properties of the blood are markedly increased. Because of such properties a dry method of operation has been devised by certain operators. This consists in not introducing any liquids into an aseptic wound, but allowing the wound surfaces to be bathed with the blood, only dry sponges being used, so that after closing the wound the cut ends of the tissues and the margins of the wound are covered with blood. Some operators maintain that the antiseptic properties of the blood are equally as great as any safe antiseptic which might be introduced into the wound. Without doubt it is a most excellent method of operation. Vaughan and others attribute the antiseptic properties of the blood to nucleins or cell globulins which it contains. He says that the origin of these substances is in the leukocytes, fibroblasts, and adenoid tissues generally.

**ASEPSIS.**

By asepsis is meant surgical cleanliness. "Sepsis" comes from the Greek and means putrefaction. The term asepsis refers to that condition where all agents and substances causing putrefaction or decomposition are absent. Inasmuch as sepsis is the condition against which nearly all the surgeon's efforts are directed, an aseptic condition would be ideal if it could be obtained. Since Dr. Henle in 1840 propounded the germ theory of disease, physicians have sought for methods to prevent bacterial growth. Lord Lister, believing that the source of sepsis was largely through the atmosphere, devised means whereby the air and the surfaces of the wound were impregnated with pulverized antiseptics. The extremes to which this and other antiseptic methods were carried undoubtedly resulted in great injury many times. The monstrous outcome of such applications, however, was the result of an erroneous idea of the source of infection. It is now known that infection comes largely from the hands of the operator, from his instruments, from the surface of the body, and foreign bodies coming in contact with the wound and that very few, if any, pathogenic micro-

organisms gain access to the wound by means of the air. Therefore, because of the irritating qualities of the antiseptics, antiseptic methods really introduced into the wound irritating substances, destroyed tissue cells and added this burden to the healthy tissues and did not render infection less likely. Having recognized the source of infection, more simple and less harmful means have been devised for destroying the pathogenic germs. It has led to the theory of asepsis. The most difficult thing to obtain in a surgical operation, or in any surgical condition, is a condition approaching asepsis, and yet it is the condition hoped for by every operator; and every method known to destroy germs without the use of irritating chemical compounds should be used and is justifiable. Heat is the best of all agents to destroy micro-organisms, therefore instruments of any description used about the body, under any circumstances whatever, whether a fresh wound is present or not, universally such instruments should be boiled. The hands of the operator can readily be sterilized, at least made sufficiently clean for all practical purposes, by the following means. The nails should be pared closely and all dirt removed from beneath them; the hands and arms should then be thoroughly scrubbed with soap, water, and a brush which has previously been made sterile by boiling. The best soap, such as green soap, or castile soap, should be used. After the hands have been thoroughly scrubbed, they may be washed in alcohol to remove the oil from the sebaceous glands and the skin. Lastly the hands may be bathed in 1:1000 solution of bichloride of mercury. Under ordinary circumstances, after such preparation, the hands will be sufficiently clean. If the hand is to be introduced into the peritoneal cavity, more elaborate preparations may be made. The idea of using sterile rubber gloves in operative procedures was looked upon favorably by many most excellent surgeons, but they have gradually given way to approved methods of cleansing the hands. The surface of the body in the neighborhood of the wound or in the field of operation may be similarly treated. After having been thoroughly scrubbed it may be washed with an antiseptic solution, and if the antiseptic causes any uneasiness, it should afterwards be removed with boiled water. Surgical dressings, ligatures, and any other objects going in or about wounds should be sterilized, not by antiseptics, but by heat. Substances entering into and going about wounds impregnated with antiseptics are uniformly irritating and harmful.

#### Preparations for an Operation.

When an operation is to take place in a room in a dwelling house, all furniture, tapestries, and curtains should be removed, and the floor and walls thoroughly scrubbed and cleansed. The table should be an iron portable one, easily rendered sterile. Where this is not obtainable, an ordinary wooden table, well scrubbed and washed with an antiseptic, will do. Other small tables, one for the anesthetist, one for sponges, one for the instruments of the operator, and another for a basin con-

taining an antiseptic solution are needed. Previous to the operation the surgeon should see that he has a goodly number of sterile towels. For an ordinary operation, say resection of the knee-joint, two or three dozen towels should be available. These towels may be made sterile by means of heat, and placed conveniently at hand for use during the operation. The patient, in any major operation, or where a general anesthetic is to be given, requires preparation. Uniformly the bowel should be evacuated of its contents by means of a high enema previous to the operation. Under no circumstances, if the operation is to take place in the morning, should the patient be allowed breakfast, as the stomach should be entirely empty. The patient should be free from any excitement, and stimulants or drugs of any kind should not be allowed. A general bath should be given. The body should be scrubbed about the flexures, genitalia, and perineum, and the head shampooed. If the operation is to be on a part of the body covered with hair, the hair should be removed by shaving, when the skin may be thoroughly scrubbed and cleansed. The method of applying antiseptic poultices, soap poultices, or other such means is needless. The field of operation may be thoroughly scrubbed and cleansed by means of soap and water, alcohol and bichloride of mercury, when several layers of sterile or antiseptic gauze may be strapped to the surface to prevent any contamination of the part so cleansed. There should also be at hand a large quantity of boiled water or of normal salt solution for the purpose of thoroughly washing out the wound. This is of the utmost importance. Water does not act as an antiseptic, but, on the other hand, dilutes and washes away the substances upon which the bacteria live. Inasmuch as it is in no case harmful, the wound may be flooded with large quantities of water and all irritating and harmful substances can be removed without difficulty. Ten gallons of water may be run through, and into all parts of a large abscess cavity with very beneficial results. The present practice of injecting antiseptics into such cavities with the hope that they will destroy the bacteria is a most vicious practice. In operations where the peritoneal cavity is opened and where septic material becomes diffused between the viscera, large quantities of normal salt solution should be run through, and into every nook and cranny so as to wash out all offending materials. The sponges used in an operation can be made of gauze or cotton enveloped by gauze. Gauze pads are perhaps the most serviceable, as they are easily sterilized. Marine sponges are rarely used and formerly in the hands of many surgeons were the vehicles of infection instead of performing the function of removing offensive materials. All the sponges entering into an operation should be counted, so that if it becomes necessary at any time to account for them, this may be done. The misfortune of closing a wound in the peritoneal cavity with a sponge in situ has happened to good operators. The towels just previous to the operation should be spread over all parts of the table and those parts of the patient's body in the region of the operation, so that previous to oper-

ating the operator has a sterile "field" before him. This field of operation should, at all hazards, be maintained aseptic. During the operation no one should be allowed to touch any septic object and then touch the field of operation. The instruments selected by the operator should be those required in the operation. Any useless array of instruments is needless and certainly looks bad. The instruments should be wrapped in a towel previous to the operation and be allowed to boil for fifteen minutes. If the operator means to ligate an artery, bone forceps are hardly necessary. On the other hand a good supply of artery forceps, which are reliable, should be at hand.

### SUPPURATION, ABSCESS, ULCER, FISTULA, AND SINUS.

Pus formation was at one time supposed to be the inevitable outcome of wounds. It has been proven erroneous. This was followed by the belief that all pus was produced by micro-organisms, which is likewise untrue. Pus, in a large majority of cases, is the result of the operations of micro-organisms within the tissues. It is not a specific infective process, but it is a form of reaction which may happen from various injurious agents. The pustules of croton oil contain true pus, and yet the pus is free from micro-organisms. Pus may be looked upon as a termination of inflammation, which may be caused by chemical agents, or bacterial action. An acute abscess is generally the result of the development of bacteria within the tissues, and as such, it will be described. Bacteria get into the tissues in various ways; sometimes at hair follicles, other times in small abrasions of the skin, and at other times at the open mouths of lymphatics in wounds. They circulate either in a healthy state or in the form of spores until they lodge in some part of the body where an inflammatory reaction follows. The beginning of the inflammation does not differ from the inflammation arising from other causes, but if the bacteria are present in large numbers the tissue changes are very rapid and the symptoms and signs of the process are more intensified. The invasion of the system by bacteria or the pus micro-organisms, in the case of suppuration, has been likened to the invasion of a country by a hostile army. The leukocytes which swarm to the inflamed area, attracted by chemotactic influences, pounce upon the germs and attempt to destroy them. The connective-tissue cells increase in number rapidly; these, too, exhibit phagocytic properties. Nature attempts to destroy the irritant. When this is impossible the proliferated connective-tissue cells, now called the round-cells of inflammation, or fibroblasts, and the leukocytes, form a wall around the bacteria. Inasmuch as the inflamed area is so crowded with leukocytes and round-cells it interferes with the flow of the fluids and the nutrition is cut off to the center of the inflamed area. Death of this central area follows. The first change occurring is a coagulation of the albuminous principles in the cell, the nucleus becomes less distinct, the protoplasm granular and cloudy (*Coagulation Necrosis*). Coagulation

necrosis is the first step in pus formation. Now this central mass which has undergone coagulation necrosis becomes liquefied by the peptonizing influence of certain ferments which are developed by the micro-organism (*Liquefaction Necrosis*). The result of the liquefying of the tissues is pus. This pus in ordinary abscess formation is limited by a membrane. It was called by the old writers a pyogenic membrane, inasmuch as they thought it produced pus. Now it is called the *Limiting Membrane* since it is this membrane which prevents the extravasation of the pus into the other tissues. Pus forms only after stasis occurs, and after the nutrition to the inflamed area has been arrested; therefore, to prevent pus formation, circulation of the fluids must be kept up. Pus of abscesses varies largely, depending upon the cause of its formation and the condition of the tissues.

**Laudable Pus.**—This term was formerly used by surgeons to indicate the pus flowing from a wound. It is usually of a specific gravity of 1028, is yellowish, yellowish-white, or a greenish fluid of the consistency of cream, with or without odor.

**Ichorous Pus** is a putrid fluid which is thin and watery and contains large numbers of the micro-organisms of putrefaction.

**Foul Pus** may be ichorous and may be due to various micro-organisms. Certain abscesses discharge this character of pus. Ischiorectal abscesses and those following typhoid fever are notoriously foul and stinking.

**Sanious Pus** is a term applied to bloody pus or that which contains coloring matter. Sometimes it is thin, reddish, and corroding.

**Fibrinous Pus** contains fibrinous masses or coagulated purulent masses. It is met with in the pus of serous cavities.

**Blue or Green Pus** is due to the presence of the *B. Pyocyaneus*.

**Serous Pus** is a serous-like fluid containing flakes of purulent matter.

**Tubercular Pus** is generally curdy, containing cheesy-like masses.

**Muco-Pus** is a term applied to the decomposed or purulent mucus found in catarrhal conditions.

**Caseation** is a term applied to the fatty degeneration of pus and dead tissues. These caseous masses may undergo calcification.

It may then be considered that pus only happens from micro-organisms when their onslaughts are so severe as to overwhelm certain portions of the tissues, thus causing death and destruction. This pus is confined, as before stated, by a limiting membrane. Pus is an offending substance nature wishes to get rid of, therefore, by the action of certain forces it burrows in the direction of least resistance. This is not always toward the surface. In the case of purulent synovitis of the knee-joint the pus generally burrows upward on either side of the thigh. Pus forming on the front of the body of a vertebra in the lumbar region, along the attachment of the psoas magnus muscle, forms a cavity in the sheath of this muscle, then burrows along down the sheath and

opens beneath Poupart's ligament. Pus may burrow a long distance. Pus from an abscess of the appendix may rupture at the umbilicus. The writer operated upon a case of this sort where the abscess had been of more than a year's standing. A rapid and complete recovery followed. In abscess on the thumb or little finger, as happens in whitlow, the pus may burrow along the sheath of the tendons and open above the anterior annular ligament of the wrist-joint. Pus may burrow from the chest cavity down the arm. Pus forming in the hip-joint may burrow in several directions. (See hip-joint disease). When it is toward the surface it gives the appearance of "pointing." This pointing is evidenced by a dark-bluish spot which afterwards becomes necrosed, and as the pus approaches the skin, it shows a yellowish color through the translucent epithelium. When pus ruptures from an abscess without the assistance of a knife, the opening is rarely sufficiently large; furthermore, necrosis of the superficial tissues results in the formation of an ugly scar; hence it should be a uniform practice, whenever pus formation is detected, to make a free incision and evacuate the pus. Pus formation is attended with an intensification of the symptoms of inflammation. The pain is more severe and more of a throbbing nature, the redness becomes more dusky, and the swelling very often edematous. The loss of function becomes more complete while the heat is greater and in large abscesses the absorption of the toxins from the abscess may be such as to cause fever and other systemic disturbances, such as anorexia and partial arrest of the secretions. Previous to the pointing of the abscess the skin becomes adherent to the deeper structures. Many times this is an indication of the formation of pus before fluctuation can be obtained. Fluctuation is the sensation obtained by holding the finger upon one side of the abscess and tapping the other side. This causes a wave-like motion in the fluid, which is transmitted to the finger. If the abscess be of sufficient size, a chill may attend the formation of pus. This chill is the result of circulatory disturbances brought about by the effect of the poisons upon the vasomotor centers. Following the chill there is usually a high fever and a drenching sweat. If the abscess be large and deep seated and is not soon evacuated of its contents, irregular chills may occur. This is one of the sure signs of pus formation. If the diagnosis can not yet be made, a tubular exploring-needle may be introduced into the abscess cavity, when the character of the contents may be determined to a certainty.

Abscess formation is generally of two kinds, *Circumscribed* and *Diffuse*. Circumscribed abscess formation is similar to that which occurs in a boil or furuncle. Diffuse pus formation is called *Phlegmon* or purulent infiltration.

**Phlegmon.**—This process may involve areas of varying sizes, from a small patch to the entire limb, and is generally due to the infection of the streptococcus pyogenes or streptococcus erysipelas. These germs are very often extremely virulent and active. The barrier set up by

the leukocytes and connective-tissue cells will not restrain them. They disseminate through the intercellular spaces and lymph channels and spread rapidly, causing intense inflammation, marked swelling, pain, and great discoloration. The pain very often is of a burning character. Necrosis of the superficial areas, because of the arrest of the circulation, is not unusual. Neighboring lymphatic glands become inflamed and enlarged. Chills may occur at the onset of the inflammation, or there may be severe chills at short intervals in conditions of rapid infection. Fever, under such circumstances, is more or less continuous, but following each chill there is a rapid rise, when it again falls to a minimum. In severe cases the fever may take on a typhoid character. In case of broken-down health, compound fracture with great destruction and injury to the soft-parts, in extravasation of the urine through the tissues, or in pus formation following an attack of an acute infectious disease, it is not unusual for the fever to be of a typhoid nature. It is a very grave condition, and means a septic intoxication, and unless evacuation of the pus and cleansing of the abscess cavity can be made, death is imminent. About the edges of the inflamed area there are red, fiery lines extending from it in forked directions, indicating that the inflammation extends along the lymphatics. Like cases may not suppurate, the leukocytes having destroyed the poisons. As soon as the tissues assert themselves and win the battle waged against the germ, a circumscribed abscess will follow, when the pus may be evacuated and the case recovers. When the pus cavity is evacuated, granulation tissue fills it up. This cicatrizes and a scar results which permanently marks the location of the abscess.

#### Varieties of Abscess.

1. **Acute**, which is the result of an active inflammatory reaction.
2. **Chronic**, which is one due to certain conditions of the tissues rather than germs. They are less active and are sometimes called strumous, cold, or tubercular.
3. **Circumscribed**, when the abscess has a well defined limiting membrane.
4. **Diffuse**, when no limiting membrane occurs.
5. **Hypostatic**, when it is the result of pus gravitating into a part.
6. **Embolic**, where the abscess is the result of an infective embolus.
7. **Encysted**, where the abscess is enclosed by a fibrinous wall.
8. **Fecal**, when the abscess contains feces.
9. **Metastatic**, when the abscess is caused by pyogenic cocci from another abscess.
10. **Hematic**, which arises from bloodclot.
11. **Milk Abscess**, an abscess of the breast in nursing women.
12. **Psoas**, an abscess in the psoas muscle.

13. **Tropical**, an abscess of the liver occurring in hot countries.
14. **Thecal**, when it occurs in the sheath of a tendon.
15. **Urinary**, when caused by the extravasation of urine.
16. **Brodie's Abscess**, is a chronic abscess of bone, most commonly occurring in the tibia.
17. **Deep Abscess**, when it occurs beneath the deep fascia.
18. **Superficial Abscess**, when it is above the deep fascia.
19. **Paget's Abscess**, one occurring from the residue of an old abscess after several years.

#### Acute Abscesses of Various Regions.

1. **Abscess of the Brain**.—See Cerebral Abscess.
2. **Abscess of the Appendix Vermiformis**.—See Appendicitis.
3. **Abscess of the Liver** may follow dysentery, appendicitis, or suppurative processes in other locations of the body. Where the abscess obstructs the gall-duct, jaundice will occur. In addition to the pain and tenderness over the liver and the enlargement of the liver, fever of an intermittent type is present, and there will be severe pain in the shoulder and back. The burrowing of the abscess towards the surface is announced by edema of the skin. Occasionally the condition is not diagnosed until late.
4. **Subphrenic Abscess**, as the term indicates, arises beneath the diaphragm, and is generally of the lesser peritoneal sac. It may arise from perforation of some of the hollow viscera, from Pott's disease, or from infection or injury of some of the viscera.
5. **Abscess of the Mediastinum** is difficult to diagnose except by the systemic signs.
6. **Abscess of the Lung** occurs in conditions of pyemia after pneumonia, or after injuries and perforating wounds of the lung.
7. **Perinephritic Abscess** is difficult to diagnose, but occasionally causes pain down the back of the leg, simulating hip-joint disease. Edema and fluctuation in the lumbar region may announce the pointing of the abscess.
8. **Ischiorectal Abscess** is caused by an infection of the cellular tissues of the ischiorectal fossa, by means of micro-organisms which have migrated from the rectum through the intestinal wall. See fistula in ano.
9. **Abscess of the Antrum of Highmore**.—See Abscess of Antrum.
10. **Postpharyngeal Abscess** may come from caries of the cervical spine. This may occasion difficulty in swallowing and breathing and puffiness in the postpharyngeal wall. Fluctuation may be felt.
11. **Prostatic and Urethral Abscesses** are attended by painful and frequent micturition or retention of urine, together with chills and fever.

**12. Abscess of the Breast** is caused by pyogenic micro-organisms entering from abrasions of the nipple, or is due to an obstruction of the milk-ducts, by pendulous breasts, or by luxations of the ribs, affecting the return circulation. The symptoms of this abscess are similar to those of abscesses in other regions.

**13. Palmar Abscess and Felons.**—See Thecal Abscess.

#### Symptoms of Acute Abscess.

(A) Local, and (B) Constitutional.

**Local Symptoms.**—1. Pain, throbbing or burning. 2. Dusky hue of the skin. 3. The skin is adherent to the underlying tissues. 4. Edema. 5. Fluctuation. 6. Great heat.

**Constitutional Symptoms.**—1. Chills, varying from a chilly sensation to distinct rigors. There may be one or several, happening irregularly, usually at the formation of each new abscess, as in pyemia. 2. Headache. 3. Muscular soreness. 4. Coated tongue. 5. Loss of appetite. 6. Sleeplessness. 7. Fever, varying from half a degree to a rise of several degrees. 8. Highly colored and scanty urine. 9. The bowels are confined. 10. Certain nerve symptoms which vary from irritability to delirium of a noisy character. Where the abscess is old and long continued it gives rise to what is called a hectic fever, which is sometimes attended by a peculiar flush upon the cheek (hectic flush). This is characteristic of tuberculosis, the fever in which is produced by pus formation.

#### Diagnosis of Acute Abscess.

The diagnosis of acute abscess formation is made by weighing the symptoms present. Where there is doubt the physician should temporize, unless urgent measures must be adopted. An exploring-needle may be introduced, which will determine the character of the contents of the tumefaction.

Abscess may be confounded with Aneurysm, when it is seated over an artery because it is pulsatile. It may be confounded with Cyst; an exploring needle will determine this. A tubercular abscess is differentiated by means of the absence of the inflammatory signs and the general condition of the patient. A rapidly growing Sarcoma has deceived some physicians, but here again an exploring-needle would determine the nature of the tumefaction. Where the character of the contents of the cavity is doubtful, cultures may be made to determine whether micro-organisms are present.

#### Treatment of Acute Abscess.

(A) Osteopathic and (B) Operative.

The Osteopathic treatment is of great value in the treatment of abscess when brought into use before pus is formed. Suppuration in

almost all forms of abscess may be arrested if seen sufficiently early. The treatment in general is similar to that of any inflammation, but is more especially directed toward relieving stasis, which must take place before pus is formed. Death of tissue anywhere is always the result of the arrest of nutrition. The treatment consists in relieving any obstruction to the circulation, whether it is within the fascia, muscles or other tissues. Relieving the obstruction and encouraging the circulation prevents stasis and the formation of abscess. In many cases the obstruction may be from bony displacements. These will be at once recognized and relief given immediately. By appropriate treatment resorption of the inflammatory products can be secured by opening up the mouths of the lymphatics and increasing this circulation. Where the pain is great it can be relieved by removing the obstruction to the circulation, thus relieving the tension. The fever may be reduced by appropriate treatment. The urinary secretions may be stimulated so that the poisons circulating within the body may be eliminated, while the bowels, if confined, should be freely opened.

**Operative.**—When suppuration is imminent, heat in the form of hot fomentations or hot poultices may be applied. In small abscesses it is perhaps the best practice to hasten pus formation and allow it to rupture of itself, unless the boil occurs on an exposed part of the body, when an incision by a small tenotome or dermal lancet may be made to evacuate the pus. Should such incision be made, the abscess should be washed out with an antiseptic solution and the cavity swabbed out and thoroughly cleansed so as to prevent further pus formation. In case of an abscess of large size a free incision should be made. The abscess cavity should be washed out with an antiseptic solution and good drainage established. Drainage is best obtained by introducing a strip of gauze, which is not too large to obstruct the free flow of the fluids, to the very bottom of the abscess. If the abscess is of large size and collapsible and of long standing the gauze should be lightly packed in so as to keep the abscess cavity distended to permit of drainage from all its parts. Drainage is the most important feature in the treatment of an open abscess. In an abscess that has opened of itself, it should be seen to by the attending physician that the opening is large enough to permit of free drainage of the fluids from it. If there be no general cause for the abscess, no systemic ailment, such as a strumous condition, syphilis, alcoholism, or a diathesis of any kind, and free drainage and antiseptics is maintained by washing out the abscess at least once daily, the abscess will readily heal in a short time. Should the abscess continue for some length of time, the antiseptics used to wash the cavity should be changed, e. g., carbolic acid one week, bichloride the next week, etc.

In abscess of the Appendix, the appendix may be removed and the pus cavity washed out. A cigarette drain may then be inserted.

In Pelvic Abscess drainage may be had by means of a glass tube. A fenestrated rubber tube may be serviceable in establishing drainage

from an abscess in joints, pleura, or other locations, but Treves' method of gauze drainage is usually the best.

In opening an abscess care should be taken to make the incision in the direction of the vessels and so as to not injure any important structures. Hilton's method of opening an abscess is an excellent one in case of abscess of the neck. This method consists in making a small incision or puncture in the abscess with a bistoury or small scalpel, when a closed artery forceps is introduced into the abscess cavity, then opened and withdrawn. While this operation is painful it is safe, for the arteries and nerves will not tear as readily as the connective tissues by which they are surrounded, hence you enlarge the opening at the least possible risk. After the abscess is evacuated, a small strip of gauze may be introduced to prevent closing of the opening and to establish drainage. The abscess should always be opened at the most dependent part so as to secure the benefit of gravity in drainage. Where the abscess is large it may be punctured and a grooved director inserted, and when it is known that no important structures lie between the grooved director and the surface the tissues may be readily divided and a large opening secured. In case of old abscess it is advisable to scrape out, with a dull curette, the inside of the abscess to get rid of the dead material, flocculent pus, and masses of dead tissue, and to permit the antiseptic solution, with which the cavity must be flooded, to get into every nook and cranny. The antiseptics used in abscesses should be, in acute abscesses, corrosive sublimate or carbolic acid solutions where free drainage can be had and there is no likelihood of the fluids being retained. Under no circumstances must peroxid of hydrogen be used unless there is a large opening and free drainage and plenty of opportunity for the gas to escape, as sometimes large quantities of gas are evolved when it comes in contact with pus. In acute abscesses, where there is not good drainage and there is much absorption of pus, the cavity should be washed out two or three times daily. Where there is good drainage once daily is sufficient, depending upon the nature of the discharge. As the abscess begins to heal the discharge will become less purulent and at the same time more serous, and as the discharge becomes less, and as the abscess heals from the bottom up, the gauze or other drainage material may be left out; not, however, until there is no possibility of any pockets forming. Boroglyceride solution and emulsions of iodoform are extensively used in chronic abscesses.

#### Dangers of Abscess.

**1. Hemorrhage.**—In certain conditions of pus formation where the pus burrows about blood-vessels, the walls of the vessels may become eroded and burst. Fatal hemorrhage has occurred from such cause.

**2. Rupture into Large Cavities.**—Where an abscess ruptures into a joint or serous cavity such as the pleura or peritoneal cavity, rapid

absorption of the pus will take place, inasmuch as these cavities are but large lymph spaces and furnish opportunity for very rapid absorption of pus, therefore a rupture into any such cavity is likely to be rapidly fatal.

**3. The Formation of Sinus or Fistula** occurs where foreign bodies remain at the bottom of the abscess cavity, where bone becomes necrosed and sequestra are formed or where the pus has burrowed through a long tortuous tract, where the abscess is poorly drained or where there is some constitutional disturbance. The fistula occurs where the pus has burrowed from one normal cavity of the body to another, or to the surface of the body.

**4. General Sepsis** takes place in diffuse pus formation where the pus extends around, through, and along the planes of connective tissue which extends around and between muscles, over bones, nerves, and blood-vessels in such a manner that rapid absorption of the toxins may take place. General sepsis may occur following the rupture of a circumscribed abscess into a large serous cavity or into the planes of connective tissue.

**5. Deformity.**—Pus formation may result in serious deformity, as happens in palmar abscess, caries of the spine, and in abscesses of the neck large and hideous scars may be formed. Abscesses of the middle ear oftentimes permanently impair the hearing. Such deformities should be anticipated and the abscess opened early so as to limit the formation of new tissue, which may bind down important structures, and the contractions of which may be unsightly.

#### Chronic or Cold Abscess.

A chronic or cold abscess is one which is not inflammatory, the signs of active inflammation being absent. It differs from acute abscess, in that it generally forms slowly; and, while the signs of inflammation are present to some extent, only in a minor degree. This abscess does not depend upon the presence of pyogenic micro-organisms. The contents of a cold abscess differ markedly from that of the acute, being very often thin and curdy, instead of thick and creamy. There are cases of superficial chronic abscess where the contents vary but slightly from the pus of an acute abscess. Its chief characteristics are that it is not inflammatory and the cause more obscure. It was formerly said to be idiopathic. They generally arise from carious bone, chronic joint disease, caseating lymphatics, and from retrograde changes taking place in connective tissue planes. The real causes of chronic abscess are bony, muscular, or fascial lesions affecting the circulation and nutrition. The tissues become debilitated and lose their resisting power. They easily undergo degeneration and form pus because of a trivial injury. These lesions may affect a part directly or reflexly. They not only constitute the most important causative factor in this disease, but also their removal will be attended by a disappear-

ance of the abscess. The depraved condition of the tissues local or general, directly the result of certain lesions, permits of the deposit of the tubercle bacillus, resulting in the formation of the tubercular abscess. By no means are all of these chronic abscesses tubercular. In the pus from some of them the tubercle bacilli may be demonstrated, but in many others not only can the tubercle bacilli not be found in the pus, but likewise not in the surrounding connective tissues. The practice of some physicians in calling all of these chronic abscesses "tubercular" is certainly bad. These abscesses may exist for months, and even years, without rupturing externally, during which time there may be no febrile reaction. Ofttimes the pus burrows for a long distance, and the sinuous tract is lined with fibrous tissue which may even, in some cases, be cartilagenous.

#### Symptoms of Chronic Abscess.

The symptoms are various, differing according to the location of the abscess; when it is due to a carious spine it is accompanied by marked spinal curvature; when associated with bone abscess it is usually very painful and accompanied by great thickening of the bone and induration of the tissues. Prior to the opening of the cold abscess no constitutional symptoms appear—no chill, no fever, no loss of appetite, or nervous symptoms, but on the other hand there is a certain amount of general debility in a large number of cases. After the abscess opens or is opened, pyogenic infection will most likely take place, when a general hectic fever follows and many times where the abscess is insufficiently drained and putrefactive changes take place in the retained discharge, the patient may grow rapidly worse and the case terminate fatally. This led old practitioners to avoid opening the abscess as long as possible, and to attempt to get rid of the diseased condition by other means. Where a chronic abscess becomes infected and the patient is debilitated, suppuration may extend over a long period. A hectic fever with the characteristic evening rise and morning remission, giving the mental picture of a wasting disease, will follow. The case may be terminated by exhaustion, renal disease, a diarrhea, or by an abscess forming in the liver.

#### Diagnosis of Cold Abscess.

The diagnosis of a cold abscess is somewhat difficult. It may be taken for blood extravasation, soft tumor, lipoma, cyst, etc. Where the diagnosis is questionable, a needle may be introduced and some of the fluid, if any is present, withdrawn.

#### Terminations of Cold Abscess.

A cold abscess after remaining quiescent for months, or even years, may again become active, enlarge, and rupture. A cold abscess may rupture upon mucous surfaces, in a serous cavity, or upon the surface

of the body. The contents may be only watery, containing curdy-like masses, or the fluids may be absorbed and this cheesy-like material may undergo calcification and remain quiescent for years. Perhaps after an injury or the person has become debilitated an abscess may arise from this cheesy mass. This is called by some writers, Residual Abscess.

#### Treatment of Cold Abscess.

In the treatment of cold abscess, constitutional derangement or bony lesions should be looked for. Whatever the derangement is, or whatever the lesion is, this should be corrected. The flow of the fluids and the nutrition in the affected tissues should be encouraged. If a person is of a constipated habit, this should be corrected. If he is suffering from general debility, his system must be built up. Every effort should be made to cure the abscess without opening, unless it enlarges, when aspiration should at first be resorted to, and the general treatment continued. In a large chronic abscess a person should lead an out-door life. If the abscess is opened it should be scraped well with a Volkmann's spoon to get rid of the detritus and dead material clinging to the abscess walls. Irrigation of the abscess cavity with antiseptic solutions and the enforcement of the most rigid cleanliness is essential.

#### Tubercular Abscess.

Tubercular abscess may occur wherever the deposit of the tubercle bacilli may take place, but this is generally in connection with bones, joints, lymphatics, and connective tissues. It differs from the ordinary chronic abscess in that the exciting cause of the disease process is the tubercle bacilli. Lesions, as misplaced bone or contracted muscle, affecting the flow of the fluids and weakening the tissues, render possible the deposit of the germs. Many of the abscesses which are tubercular, so-called, may not be tubercular, inasmuch as it is quite impossible to demonstrate the presence of the tubercle bacilli. They often happen in connection with the spine, where it is called "Pott's disease," or the hip-joint, where it is called "Morbus Coxarius," or the knee-joint, where it is popularly termed "White Swelling." They are found in persons who have inherited weakness of some sort, often where the parents or near relatives have been subjects of tuberculosis.

**Symptoms of Tubercular Abscess.**—It presents many of the symptoms of other forms of tuberculosis with chronic abscess formation. The pathology of this abscess formation is that of the deposit of the tubercle in the tissues.

**Treatment of Tubercular Abscess.**—The treatment of tubercular abscess has been greatly modified by the practice of osteopathy. The most important part of the treatment is to relieve any constitutional derangement or bony lesion which may account for the condition present. This latter idea is ridiculed by other practitioners, but the uni-

formity with which good results have been obtained by correcting such lesions and increasing the blood supply to the part, no longer leaves it open to question. In addition to the osteopathic treatment which may be instituted according as the case requires, the local treatment of the abscess may be included under the following heads:

**1. Aspiration** of the pus will sometimes lead to its disappearance. Repeated aspirations, together with other manipulative treatment, as the case requires, ought, in a large majority of cases, to be sufficient.

**2. Tapping and Irrigation** consist in removing the fluid and irrigating the cavity with an antiseptic solution. This treatment is fairly successful in some cases.

**3. Extirpating the Tubercular Area.**—This consists in dissecting out the abscess and its wall, thoroughly cleansing the wound and closing the incision or wound without drainage. This has been successful in some cases.

**4. Iodoform Emulsion Treatment.**—Iodoform was at one time extremely popular with surgeons, but the writer has never, in his experience, had any success which he felt he could conscientiously attribute to the action of iodoform emulsion injected in these cases. It may be useful as an antiseptic, but to inject it subcutaneously in the tubercular abscess or joint, is not good treatment and is hardly warranted.

**5. Simple Drainage With Antiseptics,** which is the same method as is used in the treatment of acute abscess, can be resorted to at any time, but here it should be understood that the most rigid antiseptics is necessary.

**6. Open Method.**—This method consists in laying the cavity open and cauterizing the area freely with carbolic acid and allowing the wound to heal from the bottom.

### Ulcer.

An ulcer is an open sore produced by the destruction of surface tissues. The term "ulceration" means molecular destruction of the soft-parts, in contradistinction to "gangrene," which is death of the soft-parts by mass. Molecular death of bone is called "caries." "Necrosis" means death of bone by mass. Some writers maintain that any open wound is an ulcer, but this view is hardly a good one. Ulceration is best considered as a process similar to abscess formation, which takes place in surface tissue and results in death of certain small masses of tissue—gangrene—which are cast off, or which soften and break down and are discharged. The causes of the ulcer are similar to the causes of abscess formation, viz., an abnormal circulation, deficient nerve supply, obstruction to the return circulation, deficiency in the quality and quantity of the blood distributed to the part, or to the circulation of poison within the body, or to infection, or injury—*pressure*, or to the application of

corroding chemicals, or the existence of some constitutional affection, viz., syphilis, gout, tuberculosis, etc. Inasmuch as the ulcer is open, pyogenic cocci always play an important part in the process.

**Varieties of Ulcers.—1. Simple.**—A simple or healthy ulcer presents smooth, shelving edges and a granulating base and has but little discharge.

**Treatment.**—Promote the nutrition and circulation by proper treatment and wash the ulcer daily with an antiseptic solution. Use a protective ointment in small ulcers, with several thicknesses of antiseptic gauze and cotton, the bandage being applied in the direction of the return circulation. Where the ulcer is on a part of the body where a scar will produce serious deformity, *skin grafting* should be resorted to. This operation will promote cicatrization. There are three methods generally employed. One (Tiersch's method) is that the ulcer should be brought into a healthy condition by the use of strong antiseptics, lastly being washed by boiled normal salt solution. The surface of the body from which the skin is to be removed is made aseptic and the superficial layers of the epidermis scraped off, when by means of a razor or sharp knife, small longitudinal strips of the epidermis only are removed and laid over the healthy ulcer.

The second method is to remove small bits of skin by sticking a needle between the true and false skin and then by means of a knife cutting off a small patch of epithelial cells above the needle. Numbers of these patches are removed from the part of the body, which has previously been thoroughly cleansed, and are set around over the ulcer, which has been previously rendered thoroughly aseptic. The part is then protected from any irritation or injury, when healing generally takes place rapidly. From these small "grafts" the epithelium spreads out over the healthy granulating surface.

The third method of closing an ulcer is quite successful, when it is so located that the operation is feasible. This is a sliding flap operation. A suitable flap can be taken from near the ulcer and turned over so as to cover it. After the edges of the flap have united with the margins of the ulcer the pedicle of the flap may be cut off. The wound from which the flap is removed can be closed by interrupted sutures.

**2. Fungating Ulcer.**—A fungating ulcer is generally due to an obstruction to the return circulation. This may be due to undue contraction of the tissues between the ulcer and the heart. The edges of the ulcer are apparently healthy, but the granulations rise above the surface and are exuberant, are very red and bleed easily. The discharge is generally purulent.

**Treatment.**—Remove such obstruction, cauterize the fungus growth with creosote, copper sulphate, or nitrate of silver. Afterwards it may be treated as a healthy ulcer.

**3. Edematous Ulcer.**—Edematous ulcers happen in a part of the body where the tissues are weakened and there is an obstruction to the return circulation. The person suffers from a condition of general debility and the tissues about the ulcer are edematous because of the poor circulation. The ulcer is unhealthy. The discharge is watery and quite free.

**Treatment.**—Remove the cause, i. e., obstruction to the circulation, treat the general condition, enforce cleanliness, and antisepsis. Boracic acid powdered in the ulcer or equal parts of boracic acid and acetanilid make an excellent dressing.

**4. Inflamed Ulcer.**—This term applies to ulcers where the inflammatory reaction is the most marked feature. These ulcers are generally irregular and ragged, or they may be sharp cut. The skin about is red and edematous. The discharge is generally quite watery. It is due to septic conditions where the part is frequently irritated.

**Treatment.**—Rest, relieve the irritation, elevate the part, and assist the return circulation and use antiseptic lotions frequently until the ulcer presents a healthy appearance.

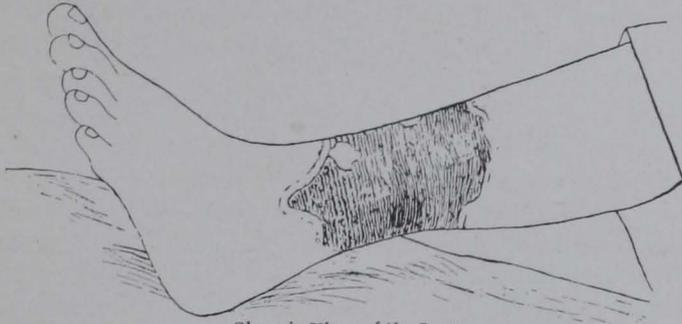
**5. Sloughing Ulcer.**—This is a severe form of ulceration. It is more frequently met with in venereal diseases, unclean conditions or in persons who have diminished vitality or suffering from general debility or some constitutional disease. The ulcer spreads rapidly, the edges are undermined and inverted; the surfaces of the ulcer are ash-gray or black. There is generally great pain and a continued fever. If the person is syphilitic, the syphilis should be treated. The dead tissues must be removed, the ulcer washed out twice daily with a 1:1000 mercurial solution, while the surfaces of the wound should be powdered with equal parts of boracic acid and acetanilid.

**6. Phagedenic Ulcer.**—These rarely occur except in very unsanitary conditions and in connection with venereal diseases, or in persons with broken-down health, or in those who are intemperate. These ulcers spread rapidly and are very destructive. In a case treated in the free clinic in the American School of Osteopathy, an ulcer arising on the side of the penis extended over the scrotum and around the buttocks. The ulcer was full of maggots and was extremely foul, yet by the use of antiseptics and proper osteopathic treatment the patient entirely recovered and suffers but little inconvenience from the extensive destruction of the tissues. The ulcer was washed out with a strong solution of permanganate potassium twice daily; after a few days a solution of mercuric chloride (1:1000) was used. It is essential to build up the person's general health before a satisfactory result can be obtained.

**7. Indolent Ulcer.**—This is a form of ulcer which simply refuses to heal and is caused by some local lesion, some constitutional defect, or by continued irritation and neglect. It is most common on the inner side of the lower third of the leg or foot where the circulation is defect-

ive. The edges of the ulcer are white and calloused, and often the ulcer is insensible to touch. The skin is often congested and edema-

FIG. 5.



Chronic Ulcer of the Leg.

tous. The base of the ulcer contains a whitish discharge and shows few, if any, granulations. These ulcers may exist for years. Simple osteopathic treatment cured a case of extensive ulceration of both lower legs which had existed continuously for thirty-eight years. Sometimes the discharge from these ulcers is very great. There is another peculiar thing in relation with these ulcers, and that is the system seems to have accommodated itself to their presence and to the discharge which takes place. Astringents or other agents arresting the secretions must not be used, but the ulcer must be allowed to gradually heal while the person's general health is improved. It was formerly thought that the healing of such ulcers would be accompanied by constitutional disturbances, inasmuch as the discharge could no longer get out of the body. The discharge from these ulcers is not a humor of any kind, but is a result of the devitalized condition of the tissues of the part.

**Treatment.**—*Better the Circulation to the Inflamed Area.*—Boric acid powdered on the ulcer twice daily or washing it with an antiseptic solution twice daily, and a little carbolized vaselin smeared around the edges to prevent the gauze dressing from sticking to the ulcer, after which equal parts of boric acid and acetanilid, or pure boric acid powdered over the ulcer, will assist healing. The important points in treating an indolent ulcer are (1) to remove the source of irritation; (2) remove the obstruction to the return circulation; (3) stimulation of the ulcer; (4) antiseptis. Where the circulation is poor the limb affected must be bandaged from the toes upward by a figure-of-8 bandage. The bandage should be silk or cotton elastic or a wet woolen bandage.

**8. Varicose Ulcer.**—A varicose ulcer is an indolent ulcer happening in a condition of varicose veins. For treatment see "Varicose Veins."

**9. Irritable Ulcer.**—The term "irritable ulcer" is applied to two kinds of ulcers, one opening about the inner surface of the ankle in women beyond middle life. It involves some of the peripheral nerves. The other is a small ulcer occurring in the rectum at the margin of the anus.

**Treatment.**—Improve the general health. Lotions of carbolic acid or carbolized ointment are generally sufficient.

**10. Tubercular Ulcer.**—These happen in tubercular subjects and are peculiar, in that they refuse to heal and are very painful. They occur in the larynx, mucous membranes, rectum, etc. The treatment should be directed towards relieving the tubercular conditions. Cauterization is sometimes useful.

**11. Syphilitic Ulcer.**—These occur in persons who have secondary or tertiary syphilis. In secondary syphilis small ulcers (mucous patches or serpiginous ulcers) occur in the mucous membranes of the mouth, pharynx, and larynx. The treatment should be directed toward relieving the syphilitic conditions. In secondary syphilis the ulcers are infectious and should always be cauterized as soon as seen to prevent any further spread of the infection. In tertiary syphilis the ulcers generally occur upon the surface of the body. These ulcers are not infectious.

**12. Gouty Ulcer.**—Gouty ulcers occur in gouty subjects and can not be cured until the diathesis is relieved.

**13. Scorbatic Ulcer.**—Scorbatic ulcers happen in subjects afflicted with scurvy. Proper diet and cleanliness will give relief.

**14. Mucous Ulcer.**—This is a form of tubercular ulceration of the skin. The treatment consists in cauterizing the ulcer or thoroughly scraping it out and then cauterizing the base.

**15. Rodent Ulcer or Jacob's Ulcer** is a form of epithelioma which requires cauterization or removal by the knife.

**16. Trophic Ulcer** is caused by some injury or disease of the central nervous system or of a nerve trunk, whereby the trophic fibres distributed to the part are destroyed, thereby cutting off this source of nutrition. These ulcers happen on the bottom of the foot in cases of hemiplegia and are frequently called perforating ulcers.

**17. Decubital Ulcer or Bed-sore** is really a form of gangrene. (See Gangrene.)

The **general treatment of Ulcers** consists in treating constitutional defects which may in any way be the cause of the ulcer, removing any obstruction to the nerve or blood supply, and removing any source of irritation whatsoever; to use cleanliness and antiseptics, to dress the ulcer once or twice daily with antiseptic gauze, first having powdered over the ulcer protonuclein, boracic acid, equal parts of boric acid and salicylic acid, aristol, or some other such powder, then over the gauze is applied a sufficient amount of absorbent cotton to absorb all the discharges. The dressing should be changed daily and the parts bandaged so as to assist the return circulation. Obstruction to nerve and blood supply can be relieved by removing whatever lesions are present.

**Sinus.**

Sinus is generally the result of pus burrowing through the tissues, and is an opening which leads from an abnormal cavity to one of the normal cavities or surface of the body. Examples of sinuses are seen in caries of the spine, psoas abscess, necrosis of the bone, in the formation of any deep seated abscess, or in the discharge of pus from the knee or hip joint. Frequently a sinus is long and tortuous. It may be lined with a pyogenic membrane or with fibrous tissue, or, in cases of long standing where the irritation has been severe, it may be lined with cartilagenous tissue. The origin of a sinus is really an unhealed abscess, healing having been prevented by bad circulation, irritating discharges, foreign bodies, general ill health, want of rest, or because of the rigidity of the walls preventing collapse. Foreign bodies, such as pieces of dead bone, bits of wood, septic ligatures, etc., may be the cause.

**Fistula.**

A fistula is an abnormal canal or opening connecting two normal cavities, or a normal cavity and the surface of the body. There are three varieties, (1) congenital, (2) traumatic, and (3) suppurative, or those produced by abscess formation and the burrowing of pus.

**Treatment.**—The treatment consists in removing the foreign body, relieving the irritation, and correcting the general health. When this is not sufficient, scrape out the sinus well and secure good drainage. In fistula, the walls should be freshened, the fistula thoroughly cleaned and made to heal from the bottom. Fistula of various parts will be discussed under "Disease and Injury of Regions."

**GANGRENE.**

**Definition.**—Gangrene is death of the tissues by mass. It may be simply a patch of skin, or mucous membrane, or an entire limb. While this has been given as one of the results of inflammation, it may have other causes, in fact, gangrene is caused by more or less sudden arrest of the nutrition to a part, and, inasmuch as this may occur without inflammation, gangrene may happen without inflammatory reaction. In severe cases of inflammation, where the reaction brings about arrest of the nutrition to a part, gangrene in one of its forms is sure to develop.

**Varieties.**

- |                           |                               |
|---------------------------|-------------------------------|
| 1. Inflammatory.          | 8. Diabetic.                  |
| 2. Traumatic.             | 9. Gangrene from ergotism.    |
| 3. Infective or Hospital. | 10. Ludwig's Angina.          |
| 4. Phagedenic.            | 11. Gangrene from frost-bite. |
| 5. Cancrum oris.          | 12. Post-febrile.             |
| 6. Carbuncle.             | 13. Symmetrical or Raynaud's. |
| 7. Decubital (Bed-Sore.)  |                               |

## Classification.

1. Dry.
2. Moist.
3. Senile.
4. Microbie.

Gangrene is so classified because of the peculiar appearance it presents under certain circumstances.

## Cause.

Gangrene is caused by any means which will interfere with the nutrition to a part as (1) injury, (2) infection, (3) thermal causes—freezing or scalding will arrest nutrition to the parts, bringing about chemical changes within the tissues thereby causing death. (4) Drugs, such as ergot, which in large doses causes a contraction of the peripheral arterioles so as to more or less cut off the circulation to a certain area. In the long continued use of carbolic acid as a lotion or where it is continuously in contact with the tissues, necrosis frequently follows. (5) Embolism and thrombosis. Plugging of an artery, either by a clot forming within the vessel or a clot lodging in the vessel and arresting the circulation to a part, may cause gangrene.

## Signs and Symptoms.

1. Lack of pulsation in the vessels in an apparently dead area.
2. Loss of heat.
3. Anesthesia.
4. Loss of function of the necrosed area.
5. Changes in color.

In inflammatory gangrene in an area which was previously red, the color is changed into yellowish, yellowish-green, or an earthy hue, or it may be dark or even black. While approaching death may have caused pain, the part is now painless and when touched with the finger is cold, as the heat quickly departs from the dead tissues. If rubbed with the hand, the epidermis loosens from the true skin, leaving the true skin a moist surface, or if the epidermis has not been removed the exudation of the fluids underneath it will cause blebs and these may be filled with yellowish or reddish fluid, due to the disorganization of the red corpuscles and a breaking up of its coloring matter. Small cavities may form in the deeper tissues, some of these being filled with a dark fluid. When the tissues are pressed upon with the hand crepitation is felt. This crepitation is due to the formation of gases from putrefactive changes which have taken place within the tissues. An emphysematous condition of the tissues is one of the surest signs of death. As the condition proceeds, foul odors will arise, due to the decomposition of the albumins and the presence of saprophytic bacteria. There will be evidences of lymphangitis and phlebitis, shown by reddish streaks extending from the inflamed area into the healthy tissues. Should the tissues arrest the spread of the gangrene, a bright red line—a *line of demarcation*—

will be established. On one side of this line is healthy tissue, on the other side dead tissue. Here nature has arrested the process and later attempts at amputation. The tissue changes which lead to death in gangrene are similar to those which take place in abscess formation, but are more extensive. The leukocytes swarm into the inflamed area, active proliferation of the tissue cells occurs, the micro-organisms have gained entrance in enormous numbers, the warfare between the micro-organisms and the tissue cells is extremely severe and in the effort of the leukocytes and connective-tissue cells to overcome the micro-organisms they crowd into the inflamed area in such vast numbers as to obstruct the circulation. Thrombosis of the smaller arterioles occurs. This leads to gangrene. Gangrene is partly due to the mechanical obstruction of the circulation and partly to the action of the poisons produced by the bacteria. As the tissues decompose sulphureted gases are liberated which produce disagreeable odors. If bacteria do not enter the tissues mummification will likely take place. At the line of demarcation the ulcerative process is set up and in the treatment of gangrene we really have a large ulcer with which to deal, and when the dead tissues are removed granulations will spring up and cicatrization takes place, as in healing of an ordinary ulcer. If the gangrene has been at all extensive there will be absorption of certain toxic products, decomposed albumins, and toxins of bacteria. These produce a condition similar to sapremia, or septic poisoning. The heart and circulation are markedly depressed, pulse feeble and quickened, the tongue is dry, furred, and brown, breath foul, features pinched and drawn, the lips, teeth, and tongue are covered with sordes, and the appetite is lost. If the necrosed tissues are not removed death from septic intoxication or exhaustion will occur. If the gangrene is of a vital part of the body, as a knuckle of the intestines, the constitutional effects of the gangrene are very great and collapse is certain and rapid. Where it is of the superficial tissues they may slough off, the ulcers healing with but little care. There are two distinct types of gangrene, which present different symptoms; these are dry and moist gangrene. Dry gangrene is the variety where apparently the fluids seem to depart from the member affected and it withers and dies. The causes of these two forms seem to be the state of the tissues at the time gangrene occurs. In dry gangrene there is an obstruction to the arterial flow and none to the venous return and the fluids already in the part are carried out. In moist gangrene there is an obstruction to the venous return, as well as an obstruction to the arterial blood, the liquid being unable to get out of the tissues. It is not unusual to find conditions where the two forms of gangrene will run into each other. Moist gangrene also occurs in tissues where there has been a pre-existing inflammation.

**Senile Gangrene** is really one form of dry gangrene. It happens in old people, or persons whose tissues have undergone degeneration because of the action of some disease or certain pathologic conditions

brought about by vicious habits. It nearly always happens in the foot or one of the toes. Close examination will reveal the fact that there is a condition of atheroma or sclero-endarteritis. There will also be arcus or annulus senilis. The disease may happen in a person 40 or 50 years of age, but usually occurs in subjects from 70 to 80 or 90. In heavy drinkers and syphilitics, the arteries undergo degenerative changes, the walls become weakened because of endarteritis, calcification of this inflammatory tissue occurs, the artery is no longer able to respond to the call of the tissues for an increase in the nutritious materials. Sometimes the arteries may be so calcified as to be very brittle. Cases may happen which are due to thrombosis of the superficial femoral artery. In any case, because of the limited blood supply, any little injury will lead to destructive changes. It may begin as a pin prick, it may arise from an ingrown toe nail, or from a scratch or cut sustained in trimming the nail, or in paring a corn the skin may be slightly wounded. The wound becomes extremely painful and burns terrifically. The tissues become red and swollen and finally die. The tissues undergo the same changes as in other forms of gangrene, except that it is nearly always a dry process. The tissues show no evidence of establishing a line of demarcation or limiting the gangrenous process. There may be considerable absorption of septic materials from the gangrenous area which will cause great depression, death generally following quickly. In some instances the case may continue over a period of some months or even years. Nature will establish a line of demarcation at that point where the tissues receive the proper amount of nutrition. When gangrene happens in the toe, amputation should be done above the ankle. If it extends back onto the foot, it is advisable to amputate above the knee. Amputation should not be performed until there is some indication of the point where the chief obstruction to the circulation is located. The operation should be done above this point, if possible.

**Microbic or Spreading Gangrene**, as it is sometimes called, is that form whose chief cause is infection by certain micro-organisms; it may be the *Streptococcus pyogenes*, or erysipelas, *B. edematous maligni*, *B. coli communis*, etc. Rapid infection in conditions where the blood supply is limited or where the part has sustained injury and the person is in a debilitated state, will cause the spreading gangrene accompanied by an emphysematous condition of the tissues, produced by the development of gases from the action of the micro-organisms. Some writers hold that the gangrene is brought about by the action of the poisons of the germ, but these poisons only act by limiting the nutrition to the part. In fact gangrene is always caused by defective nutrition, except perhaps in cases where the injury is so great as to pulverize or crush the tissues, so the germs act only by arresting the nutrition. Fortunately this form of gangrene is rare. It happens in illy-nourished people under bad hygienic surroundings. It is alarmingly and rapidly fatal. It is most common after bad fractures with extensive injuries to the soft-parts. The limb becomes enormously swollen and the pulse below the

injury is absent. The member becomes cold within 36 to 48 hours and it may turn green or a greenish-black hue. Death does not seem to take place in a single patch, but an extensive area, in fact sometimes the whole limb dies apparently almost simultaneously. The products carried back into the healthy tissues cause extensive inflammation and enlargement of the lymphatics. No line of demarcation forms, while the patient suffers from septic intoxication; death quickly follows from collapse. It is not unusual to find the temperature subnormal. Traumatic or spreading gangrene must not be confounded with erysipelas. Erysipelas shows a red inflamed area. Traumatic or spreading gangrene is at first purple and finally turns to a dark greenish color. The surgeon is often at a loss to know when to amputate. If, in his judgment, the injury is so extensive as to cause gangrene, amputation should be done at once. After spreading gangrene has set in he may amputate higher up or he may wait for a line of demarcation, which sometimes never forms. In such cases, death follows quickly. If it is doubtful what should be done, the conditions presenting in each individual case should decide that one. If the surgeon feels that it requires an amputation to save the life of the patient, it is his duty to perform such an operation with the least possible delay. If he believes it is best to temporize, that should be done. At all events the conditions should be explained to the patient or the patient's next friend, so he may appreciate them and his consent obtained for amputation. In case the person is in an unconscious state and he has no next friend, or any relatives, the surgeon should do that which he feels is his duty.

**Infective or Hospital Gangrene** is said by some writers to be the same as Wound Diphtheria and Sloughing Phagedena. The term "Hospital Gangrene" seems to refer to a kind of gangrene which does not happen in this age, but formerly occurred in poorly ventilated and unsanitary and overcrowded hospitals. In short, it occurs under filthy conditions in debilitated people. It is a rapidly spreading and infectious form of microbial gangrene. Hutchinson says it is Syphilitic Phagedena.

**Treatment of Gangrene.**—As soon as the injured member comes under the observation of the physician, if it is not dead, it should be enveloped in cotton wool, heat applied, and the part elevated to assist the return circulation. All efforts should be made to restore life to the part by assisting the circulation by whatever manipulation may be necessary. The patient should be supported with nourishing food and stimulants. If there is a wound in the tissues the strictest cleanliness and asepsis should be maintained. The part should be thoroughly cleansed and good drainage secured. If the member begins to die it should be constantly kept moist with a solution of 1:5000 bichloride of mercury and as soon as the line of demarcation sets up amputation should be performed. If the line of demarcation is tardy in forming, the dead tissues become swollen and edematous and noxious gases are produced, punctures in the dead tissue should be made by a sharp

instrument and the member wrapped with cloths saturated with a 1:1000 solution of bichloride of mercury. Every effort should be made to destroy all micro-organisms in the dead tissues. If this is thoroughly done the part will not emit any stinking odor; also the tissues will more likely arrest the spread of the gangrenous process. As soon, then, as the line of demarcation is set up, amputation can be performed far enough up so that a healthy flap can be secured. In cases of hospital gangrene, stronger antiseptics may be necessary over the sloughing area. A solution of 1:500 mercuric chloride should be used and the slough and dead tissues should be trimmed off and the antiseptic solution be introduced into all crevices of the slough by means of a swab. One or two such treatments will be sufficient to stop the destructive process, then milder antiseptics may be used. The part should be kept dry by being powdered over with iodoform or equal parts of boric acid and acetanilid. It should be dressed frequently in order to get rid of the secretions from the slough and to not allow the fluids to decompose in the dressing. In traumatic gangrene the treatment will largely depend upon the judgment of the physician as to whether or not he can save the limb; if he feels he can not, amputation is necessary. After amputation, the stump should be treated the same as an ordinary amputation stump. If the amputation is done after gangrene has set up, the dead part should be thoroughly wrapped in cloths saturated in a 1:5000 solution of bichloride of mercury so as to permit of no opportunity for infection or the return of the gangrene in the stump.

**Cancrum Oris** is sloughing of the inside of the cheek in ill-fed and ill-nourished children. The course of the disease is extremely rapid and terribly destructive. If not treated with the utmost vigilance sloughing will take place through the cheek onto the face. As soon as the case is seen, the physician should at once cauterize the slough with carbolic acid or nitric acid. After cauterization the mouth should be rinsed and cleansed thoroughly and frequently with an antiseptic solution and the patient should be kept in a well-ventilated and clean apartment and be given supportive treatment.

**Phagedena** is described under Hospital Gangrene and Sloughing Phagedenic Ulcers.

**Carbuncle.**—Occasionally in debilitated persons where the case is neglected the formation of a carbuncle, which is evidenced by numerous small boils over a certain area, may lead to gangrene of a mass of the tissues. The treatment for the case is to open the boils and wash them several times daily with a 1:1000 solution of bichloride of mercury. The patient's general health should be treated and any local or spinal lesions found should be removed. These cases usually terminate favorably.

**Decubital Gangrene** is a variety of gangrene which occurs from prolonged pressure upon an area, cutting off the circulation and causing it to slough. It happens in persons confined to their beds because of

some wasting-disease, or in paralytics where the tissues are deprived of nerve supply. The trophic influences being withdrawn, pressure cuts off the circulation and the part dies. The first sign of decubital gangrene is perhaps a little reddish pimple, upon the top of which a little black spot appears and this gradually spreads to an area of considerable size, depending upon the state of the tissues. Occasionally, in paralytic cases, the urine is voided involuntarily and as it dribbles away and saturates the clothing it adds to the irritation, when a little fold of the sheet or a small pin scratch or insect bite may be the starting point of an inflammation which results in the destruction of the tissues, forming what is popularly known as a "Bed-sore." The location of these sores is usually over the back part of the sacrum and the posterior part of the ilium or over the trochanter or sides of the buttock, because of the patient lying continuously upon these bony prominences. A pressure-sore sometimes happens upon the heel or one of the condyles of the humerus because of the unequal pressure of a splint.

**The Treatment** of decubital gangrene or bed-sore is first preventive. The preventive treatment is especially important because in many cases it is almost impossible to heal the sore after it is once formed, therefore if it is prevented an infinite amount of pain and trouble may be avoided. It is well enough in these cases, as soon as the part shows any signs of irritation, to rub the surface with alcohol and dust it with oxid of zinc or talcum powder. When any particular point shows irritation an air-cushion may be used to remove the pressure from that point. If the person is a paralytic and can afford it, a water-bed should be used. This equalizes the pressure on all parts of the body in contact with the bed. Furthermore the strictest cleanliness should be maintained. If the urine has been in the habit of coming in contact with the skin it should be collected by means of a urinal. Care should be exercised in the use of a bed-pan and the parts kept dry and free from irritation or pressure. After a bed-sore is once formed it should be treated the same as an ordinary ulcer, pressure being kept off and the strictest cleanliness enforced. Do not use peroxid of hydrogen continuously as a cleansing agent, as it will stop cicatrization. There are numerous preparations which are of advantage. The history of these sores will extend over a period of some weeks, perhaps some months, so that the antiseptic will necessarily need to be varied. The ulcer should be dressed at least twice daily. The edges of the sore should be greased with a little carbolized vaselin and several layers of antiseptic gauze applied after the sore has been dusted with equal parts of boracic acid and acetanilid. Over the gauze a considerable mass of cotton should be placed. This will prevent any secretions getting into the sore and will keep it clean. If pressure is removed, the ulcer may then be in condition to administer another part of the treatment, which is of the very greatest importance, that is, to stimulate the nerve and blood supply to the ulcer. Osteopathic practice has shown that many very extensive decubital ulcers can be successfully treated. In fact it

seems to be the only method of curing very bad cases or the only hope of saving the life of persons whose spines have sustained extensive injury high up. This manipulation must be varied according to the cause, but is directed towards securing the proper blood and nerve supply. The method by which these sores may be cleansed is this: Kelly's rubber-pan should be placed under the buttocks. The sore is washed out by means of an irrigating apparatus filled with an antiseptic solution. The irrigating apparatus may be either a fountain syringe or a large glass jar having a small rubber hose leading from it. Protonuclein or other antiseptic powder may be dusted over the sore, the edge of the ulcer smeared with carbolized vaselin, and several layers of antiseptic gauze should be applied twice daily. Sometimes the destruction of the tissues from these bed-sores is very extensive, but as soon as the dead tissues slough away, if the part becomes healthy it will show a red or pink granulating surface. Sepsis under unsanitary and neglected conditions may occur, the gangrenous process extending to the deeper tissues.

**Diabetic Gangrene.**—It is a peculiar fact that gangrene happens with the slightest provocation in diabetes mellitus. The gangrene seems to be caused by the general defective nutrition, perhaps also by the presence of sugar in the blood. It may happen in the feet or legs, in the genitalia, or over the buttocks, back, hands, or face. It may simply affect a small area or a large mass of the tissues. It may happen at any time in the clinical history of diabetes. An injury seems to be necessary, but this may be only trivial. Very often there are some prodromic symptoms, sometimes not. If it comes from traumatism there are prodromic symptoms, such as violent pain, together with a red inflamed condition of the surface. The part turns cold and loses sensation. This form of gangrene is generally moist. The line of demarcation is not so readily set up. The case calls for the treatment of diabetes conjointly with gangrene. It spreads more rapidly than senile gangrene and is very often covered over with blisters. Operations should be performed only where nature establishes a line of demarcation. Diabetes mellitus is best treated by well known osteopathic methods. Should nature show an effort at arresting the process, the remainder of the treatment is clearly surgical.

**Gangrene from Ergotism.**—Ergot, when taken internally, among other things produces a spasm or contraction of the muscular fibres in the walls of the arteries. This affects the peripheral arterioles more than the large arteries. The spasm may be sufficiently great to so arrest the nutrition that gangrene may occur. Osler says that the gangrene is first preceded by anesthesia, muscular cramp, tingling, pain, itching, and gradual blood sepsis in certain vascular areas. History of the taking of ergot, together with the presence of the above named symptoms, should be sufficient to make a diagnosis. The gangrene is generally superficial and terminal and is very often symmetrical and may involve the toes of both feet, or may involve both limbs. Death

is said to have occurred in from ten to twelve days in very acute cases. Where the gangrene is superficial the parts should be washed twice daily with antiseptic solutions and the dead crusts should be trimmed off with forceps and scissors.

**Ludwig's Angina** is hardly a form of gangrene, but is a form of abscess of the submaxillary gland. It is said to be a condition of infection of the gland with the streptococcus pyogenes. Occasionally the abscess formation is attended by gangrene. The swelling is rapid and the pain extremely severe, the person being unable to open the mouth. Occasionally the swelling may extend back into the pharynx and back part of the tongue and cause edema of the glottis. As soon as fluctuation can be detected the abscess should be opened and the inside of the mouth and the abscess cavity should be thoroughly cleansed with an antiseptic solution and the person given supportive treatment.

**Gangrene from Frost-Bite.**—Frost-bite is more common on the exposed parts of the body and is extensive according to the exposure. It causes contraction of the arterioles, drives the blood out of the tissues, arrests the nutrition and the part becomes stiff, cold, and numb. After the tissues become warm the vessels dilate because of weakness, and congestion and inflammation follow. If the part has been cold sufficiently long to entirely arrest the nutrition, the part will likely die, but if the tissues have become only seriously devitalized a severe inflammation may result and this inflammation terminate in gangrene. The inflammation which is caused by exposure to cold is attended by a severe burning sensation, followed by great pain. Sometimes the cold is sufficiently great to actually disorganize the tissues. Especially is this true where the part is very cold, or is cold for a considerable length of time and then quickly brought to its normal temperature. The rapid changes in temperature seem to bring about destructive chemical changes in the blood and tissues. The area which has become livid with cold and which is not yet believed to be dead, should be first treated by friction with snow or towels soaked in ice water, and the part gradually brought to the normal temperature. This will frequently avoid serious inflammation. Amputation should be done only after the line of demarcation has been thoroughly established. Where the ends of the fingers and toes have died the part should be treated antiseptically and here it must be borne in mind that if the tissues slough and a sore results, that this sore will heal very slowly and that the slough should be removed after it has been loosened by nature. The ulcer should be treated as an ordinary open sore. If gangrene follows in a considerable area, the treatment, before the line of demarcation has been set up, is hot fomentations of antiseptic solutions. As in all cases of gangrene, the support of the patient is of the utmost importance.

**Postfebrile Gangrene** is a form following a severe attack of continued fever. It most frequently follows enteric fever, but may follow typhus fever, scarlet fever, measles, influenza, etc. It is most usual in the lower

extremities, but may happen in the upper extremities or in the upper parts of the body. The gangrene is generally believed to be due to embolism following endocarditis. In young girls gangrene is apt to occur in the genitalia. It is said that now and then the disease arises from phlebitis with the formation of thrombi. So in continued fevers examination of the extremities should be made from time to time to determine the presence of gangrene. The treatment after gangrene has set up, is antiseptis until the line of demarcation is established. Secondly, remove any lesions which will obstruct the return circulation or interfere with the nutrition of the tissues. This being removed and the line of demarcation set up, if the gangrene is sufficiently extensive, surgical interference is demanded.

**Symmetrical or Raynaud's Gangrene** occurs in Raynaud's disease. This disease is said to be a vasomotor neurosis which occurs in children and young adults. Clinical experience shows that there are distinct spinal lesions which account for the condition. The attacks appear in the tissues symmetrically, e. g., fingers and toes. The parts become cold, dead and bloodless, following severe mental excitement or injury. In some cases the part becomes livid and there is local asphyxia similar to a chilblain. The patient complains of shooting pains and tingling in the part. After local asphyxia occurs the prognosis should be guarded for gangrene is likely to happen. When death is about to occur the part becomes dark and blebs may arise. There is local coldness and anesthesia and the line of demarcation is generally quickly set up. The treatment is to restore the circulation and remove the pressure from the nerves. After the part has died antiseptis and surgical measures are necessary.

## SEPTIC AND INFECTIVE DISEASES.

### Classification.

#### A. Septic Diseases.

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|-------------------------|-------------|
| 1. Septic Inflammation. | 3. Sæpæmia. |
| 2. Traumatic fever.     |             |

#### B. Infective Diseases.

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|-----------------------|------------------------|
| 1. Suppuration.       | 10. Malignant pustule. |
| 2. Cellulitis.        | 11. Actinomycosis.     |
| 3. Septicæmia.        | 12. Tuberculosis.      |
| 4. Pyæmia.            | 13. Glanders.          |
| 5. Hospital gangrene. | 14. Syphilis.          |
| 6. Wound diphtheria.  | 15. Gonorrhæa.         |
| 7. Erysipelas.        | 16. Scrofula.          |
| 8. Tetanus.           | 17. Rachitis.          |
| 9. Hydrophobia.       | 18. Scurvy.            |

### Septic Diseases.

The diseases included under this head are due to the absorption of certain chemical products of putrefaction which causes local inflammation and certain systemic disturbances. Fevers following injury are variously classified by different writers, but the author prefers to include under septic diseases those conditions due to the absorption of

certain alkaloids or putrefactive substances which are not necessarily the result of bacterial action, but perhaps may be due to the decomposition of albuminous products in the wound. The nature of these products is not known. They do not multiply in the body and when the wound is freely opened the disease symptoms disappear. The symptoms to which they give rise are often severe in proportion to the amount of absorption, as is instanced in poorly drained abscess cavities. The freer the drainage the less fever and other constitutional symptoms. Furthermore, the poisons are not infective and the disease process does not extend to other parts of the body. It is said by some that the poisons are due to the multiplication of saprophytic bacteria in the secretions of the wound or cavity, so that the disease is virtually a toxemia. There seems to be considerable ground for this belief, inasmuch as in foul wounds and poorly drained cavities there is generally a considerable amount of dead tissue upon which these otherwise harmless saprophytes may grow. Also, in cases of gangrene after the member has died, amputation is many times followed by recovery. Previous to the amputation there may have been marked systemic disturbances, high fever, delirium, etc., the symptoms being produced by the absorption of the poisonous products from the decomposition of the albuminous fluids in the tissues and by the growth and development of the saprophytic bacteria. The reason for no absorption of poisons afterward is that the bacteria being saprophytes, live only on the dead tissues.

**Septic Inflammation.**—The pathological process of septic inflammation is similar to that of acute suppuration or acute inflammation from chemical cause.

**Traumatic or Wound Fever.**—There are various grades of traumatic fever. Following a major operation it is not unusual, in fact it is the rule, for the temperature to rise from one-half to one and one-half degrees. The person is more or less uncomfortable and may manifest some nervous symptoms. Under other circumstances the temperature may rise to 103 degrees F., this being accompanied by a general malaise with delirium. In the milder form the absorption of the broken-up nitrogenous compounds in the wound probably causes the fever, whereas in the severe form a certain number of germs may have entered the wound and these having caused more or less putrefaction the fever and other symptoms follow. These processes come within twelve to twenty-four hours after the injury. They disappear without serious damage. Either the poisonous products are taken up by the lymph channels and carried elsewhere and gotten rid of by the eliminating organs, or the products are discharged from the wound, nature having set up a wall of granulation tissue for the protection of the system from the absorption of these toxic products. This is traumatic fever or wound fever.

#### Sapremia.

Sapremia is generally considered to be the expression of the absorption of the toxic products from retained secretions where bacteria are

causing active fermentation. In fact, sapremia may be associated with severe forms of poisoning. It is thought milder grades of sepsis terminate in severer forms, therefore, what first was a sapremia may terminate in septicemia or pyemia. Sapremia calls for quick and vigorous treatment. If it be from a wound, it demands immediate drainage. If the wound has been closed it should be opened and thoroughly washed out, all the poisonous products and germs removed and free drainage established. Sapremia occurs under three conditions: (1) extensive wounds imperfectly drained which were not previously rendered aseptic; (2) wounds of serous cavities where there is abundant opportunity for the absorption of poisonous products, and (3) from granulating abscess cavities where the external opening is too small to permit of drainage. Very severe conditions may be fatal—this is unusual. The poisons act chiefly upon the blood and nerve centers, very often producing decomposition of the red corpuscles, resulting in a form of petechia. It sometimes acts upon the nerve centers, producing delirium, or sometimes thrombosis of some of the capillaries may occur. Microscopic examination made immediately after death shows that the tissues contain no micro-organisms.

**Symptoms of Sapremia.**—Chill or chilly feelings, vomiting or loss of appetite, headache, malaise, muscular soreness; the pulse is rapid and in severe cases becomes very weak, the temperature in the severe forms reaches 103 or 104 degrees F. If the absorption is very rapid, collapse may take place rapidly. Under such circumstances coma follows unconsciousness and delirium and the patient dies.

**Treatment.**—The treatment is directed towards the removal of the source of the poisons. Opening the wound and washing it out freely with antiseptics is sufficient. In operation cases, sapremia calls for the removal of part of the sutures and establishing drainage. Pent-up and decomposed pus or secretions give rise to the disease, hence treatment should, as in the treatment of any ailment, be directed towards removing the cause.

### Suppuration and Cellulitis

have been described under circumscribed and diffuse abscess formation.

#### Septicemia.

Septicemia or "Blood-poisoning" is a general infective disease usually produced by the pyogenic micro-organisms, in contradistinction to septic processes, which are caused by the products of saprophytic bacteria. In septicemia these pyogenic micro-organisms develop at such an appallingly rapid rate and are present in such immense numbers that they swarm into the tissues, passing by means of the blood and lymph channels into the planes of connective tissues and producing such virulent poisons that the patient is overwhelmed. Sometimes he looks as if he had been struck down by some terrible malady. The disease called "Septicemia" presents a clinical picture

often seen and easily recognized. In some cases diagnosed as septicemia, micro-organisms are not found in the blood, but they exist in the tissues around the wound and the toxic products of the bacteria are produced in such immense quantities that the clinical picture is the same, whether the germs exist in the circulation or not. It differs from pyemia, in that in the latter there is multiple or metastatic abscess formation. It does not follow that because the bacteria have entered the circulation that multiple abscess will occur. Death may follow a rapid absorption of the germs before the formation of multiple abscess can take place. Conditions of septicemia and pyemia may occur coincidentally or septicemia merge into pyemia.

**Pathology.**—First there is local infection of the pyogenic cocci and there may be phlegmonous signs of a rapidly spreading inflammation. The wound, if there be one, is generally foul, coated over with a grayish covering and looks unhealthy. The secretion is yellowish and has a peculiar odor. The cocci develop within the tissues and spread through the lymphatics. In some cases they reach the circulation, when they increase and multiply in the blood. It is not unusual that cultures made from the blood will show large numbers of streptococci. These travel into the minutest vessels and finally reach the heart and develop upon the valves, which condition happens in malignant endocarditis. This may finally lead to the formation of infective emboli and result in pyemia. In other cases thrombi may form in the veins in the infected area. These clots being dislodged, form infective emboli, which may finally lead to general pyemia. On post-mortem examination there is a general congestion of the viscera in the gastro-intestinal tract. The intestines and peritoneum are frequently covered with flakes of coagulated lymph. These coagula often represent pure cultures of the streptococcus pyogenes. The peritoneum and pleura, together with the nerve centers, are all congested and frequently petechial spots may be seen. In more prolonged cases peritonitis or pleurisy or pneumonia or inflammation of other viscera may be present, and it is not unusual for the serous cavities to contain blood-stained serum. The spleen and lymphatic glands, in fact, all adenoid tissues, are greatly enlarged and congested. Doubtless many times micro-organisms enter the blood and are lost sight of, perish and do no harm. When they lodge in the parenchyma of the lung, liver, or kidney, they may increase and multiply and result in pyemia.

**Cause.**—The cause of septicemia, as has been indicated, is pyogenic micro-organisms. Sometimes several germs may be associated, bacilli and micrococci being present. In virulent cases there may be only one micro-organism doing the damage, but in all cases these germs have been introduced into the tissues in immense numbers, either through a wound or the open mouths of vessels, as in cases of puerperal septicemia. Where infection takes place in wounds the result of operation, it is caused by the septic condition already present in the patient, or

because of an unclean condition of the field of operation, or the germs have been derived from the instruments, sponges, ligatures, or the hands of the operator, or from something introduced into the wound during the operation. It is singular how much filth nature will apparently get rid of sometimes. Still, on the other hand, septicemia may follow when apparently considerable precaution has been taken. This may be explained by the fact that while streptococci are present, they may vary in virulence, in one case not producing serious symptoms, whereas in another the infection is obviously fatal at the beginning. The importance and frequency with which streptococci infection accompanies many of the acute infectious diseases in the puerperal state and in injuries is probably not sufficiently appreciated. In premature delivery brought about by measles, whooping cough, and similar diseases, septicemia is very likely to happen and is usually alarmingly fatal. While other of the pus germs may produce this disease, none is so rapidly fatal or produces such alarming symptoms as the streptococcus pyogenes or streptococcus erysipelatis. In hospitals where these cases occur they should be isolated. Clothing infected by them should be fumigated.

**Symptoms.**—The disease is generally introduced by a chill or chilly feelings. The rigor may be very severe. There may be several chills closely following each other, during the first twelve to twenty-four hours, but after that, if there are other chills, it usually indicates renewed absorption of toxic material or the formation of an abscess. The temperature rises rapidly to 103, 104, or 105 degrees F. There is at first nausea and vomiting, loss of appetite and the person looks dazed. The symptoms may take on a typhoid nature. The secretions are arrested, urine high-colored, and the patient greatly prostrated. The pulse, at first rapid and thready, becomes soft and weak. The patient soon becomes unconscious and delirium appears. In some cases there is great and rapid prostration, so that the person dies in a few days. The writer once saw a case of puerperal septicemia, following delivery at term attended by a mid-wife, where death occurred within forty-eight hours. On autopsy the peritoneum and bowels were markedly congested and of a reddish-black color. The lymph in the peritoneal cavity was coagulated in flakes.

**Treatment.**—The treatment is almost entirely preventive, for little can be done in the way of cure. The reason is, no agent introduced into the system is of any use after the poisons have entered the circulation. Antistreptococcic serum has been used, and some have claimed to obtain good results, but the statements are unreliable. Antistreptococcic serum is worthless. After infection has taken place, free incision, drainage, and curetting, together with frequent lavage of the infected area, may accomplish some good, but it is hardly likely, for blood infection is fatal. Nourishment and support of the patient, together with free use of stimulants, may assist the tissues in overcoming the onslaughts of the germ.

### Pyemia.

Pyemia is distinguished from septicemia by the formation of metastatic abscesses in other parts of the body. It is but a special stage of septicemia in which abscesses are formed. Prior to the formation of the abscesses the clinical history of the two diseases is alike and indistinguishable.

**Cause.**—Without doubt the cause of the disease is the entrance into the tissue of pyogenic micro-organisms which have found their way there through the open mouths of lymphatics or veins. The disease generally develops amidst unhygienic surroundings or in ill-nourished and debilitated subjects, in over-crowded hospitals which are poorly ventilated and drained, and where there exist numbers of foul wounds. It occurs in alcoholic and diabetic subjects or in persons with low resisting power. It generally occurs in connection with a wound. The poisonous chemical products absorbed from the wound debilitate the person to that extent that the micro-organisms absorbed circulate through the fluids in the body, lodging, in the parenchyma of some organ, producing the disease. The abscesses are often caused by infective emboli. Where these emboli lodge suppuration occurs, and, inasmuch as this generally takes place in some internal organ, clots form in the small veins and capillaries. These becoming dislodged, are carried back to the heart, when they are sent to some distant organ, where they lodge and, being infected, form another abscess. There are, therefore, two chief agents acting, one the poisonous products produced by the cocci, debilitating the system, and the other the deposit of the cocci and the formation of abscess. This abscess interferes with the function of the tissues in which it is located, causing the symptoms to vary in individual cases. Old writers mention idiopathic pyemia, but such cases do not occur. Abscesses may arise from various causes. (See abscess formation.) These abscesses, then, may be the exciting cause of the pyemia, pus having been absorbed from this cavity. Pyemia may follow typhoid fever, but in this case absorption takes place from the septic ulcers in the lower part of the small intestine. It is frequently associated with bone disease, osteomyelitis, osteitis, or periostitis. In some cases it arises from hospital gangrene, diffuse cellulitis, or abscesses of erysipelatous origin, or from gonorrhoea. Ulcerative endocarditis may happen in rheumatism and many of the acute infectious diseases. Pyogenic cocci have entered the system through abrasions of the skin and lodge on the valves because of the weakened and unresisting condition of the tissues, then because of the clot, infective emboli occur, pyemia resulting. It has been known to follow dysentery. Trivial operations seem in some cases to have caused the disease, but here it is evidently due to infection introduced by the operator.

**Pathology.**—The post-mortem appearance of the tissues is similar to that of septicemia, with the addition of collections of pus distributed through the body in small masses. There is the same rapid tendency to the disintegration of the blood, subserous and subcutaneous extravasation

and congestion as occur in septicemia. The body is generally greatly emaciated, often jaundiced, and of a dirty or dirty-yellowish color. Purulent collections may be found in the serous cavities or in the joints or connective tissues generally. The abscesses vary from pin-head foci to the size of a nut. The lung may be honey-combed with abscesses the size of a pea. The viscera affected are, in order of frequency, the lung, liver, spleen, kidney, and brain. The abscesses occurring in the parenchyma of an organ are caused by thrombosis of the peripheral arterioles. Where pyemia is caused by wounds in the rectum, visceral abscesses occur first in the liver, since the blood must pass through the capillaries of that organ before it enters the general circulation. The pus is generally of a sweetish odor and is rarely, if ever, fetid, and in case of abscess in the lung the breath of the patient has a sweetish odor. As in septicemia, when there is a wound it is unhealthy and is surrounded by an inflammatory area and covered over by pus or dying tissues, or oftentimes by a grayish membrane. The veins leading from the wound generally contain a large number of thrombi which undergo purulent softening. The fragments which protrude out into the blood stream become dislodged and are carried to other parts of the body. Sometimes these thrombi form in small veins, extending back towards the heart into large venous trunks. Besides the foregoing conditions, inflammatory masses containing numbers of micro-organisms may be found in various parts of the body. The conditions present in pyemia may be caused in several ways. The visceral abscesses are largely due to embolism of the peripheral arterioles or capillaries, the septic products having come from venous thrombi, vegetations on the valves of the heart, or at the beginning of the arteries. In other cases the micro-organisms may have migrated through the walls of the vessels and upon entering the circulation may lodge in an organ where the circulation is weak, or having penetrated a mucous or serous membrane, they get into the lymphatics, finally the general circulation, when they may be deposited in a joint, causing purulent inflammation. The diffuse purulent infiltration of a joint is said by some to be due to the general poisoned condition of the system, and the lodgement at the joint of poisonous products. In many cases, as is indicated above, ulcerative endocarditis is caused by the germs getting into the system. An infected clot is formed upon the valve, when abscesses in various parts of the body are produced, this being the distributing point from which infectious emboli arise. Following typhoid fever, after some months an abscess may arise. This can only be explained by the fact that the pus micro-organisms get into the circulation, and not being destroyed, lodge and remain in a quiescent state for some time, finally forming abscesses. From this focus general infection may follow.

**Symptoms.**—The symptoms of pyemia may at first be quite similar to septicemia, but differ in that at the formation of each new abscess a separate and distinct rigor occurs, followed by a high temperature and

a drenching sweat. The fever is of a mild or severe hectic type. After the chill the temperature may rise to 105 degrees F., depending upon the amount of absorption of pus. It will rise in the evening to 103 or 104 degrees F., and drop in the morning to perhaps 100 or 101 degrees F. While the pus is pent up in the system the patient is not free of fever. In some instances where nature is fairly successful in walling off the abscess the temperature may almost approach normal. The pulse is quick and weak, the tongue, at first red and moist, becomes dry and brown as the case is more prolonged. Sordes form in the mouth, on the lips and teeth, and the breath becomes foul. The body wastes rapidly, the skin is frequently jaundiced (hepatogenous) because of the formation of an abscess in the liver which obstructs the gall-duct, or it may be caused by the disintegration of the blood (hematogenous) by the pyogenic micro-organisms. The face is anxious and pinched, the features drawn, the temperature high, and the hectic flush usually marked. It is not unusual for eruptions to take place on the skin or ulcerations in the fauces. The breath and exhalations from the body have a peculiar sweet odor. As the different structures are affected, peritonitis, pleuritis, or pericarditis may occur. Diarrhea may set in and this is generally exhausting and followed by delirium. The patient generally dies of exhaustion during the second or third week of the disease. It is said there are rare cases where the primary wound may heal.

**Prognosis.**—The prognosis is extremely unfavorable. It is only when the disease seems to run a chronic sort of course that there is any hope of recovery. In this case the viscera do not seem to be affected, but the connective tissues and joints suffer most. The patient may die after some weeks of lingering or may finally recover after the disease has existed for some months.

**Treatment.**—Little or nothing can be done in the way of treatment, inasmuch as we must depend upon the system to get rid of the micro-organisms, and when the infection is rapid this seems impossible. When abscesses form the pus should at once be evacuated. This is impossible when it occurs in the lung, brain, or other important organ. Where the seat of trouble can be reached it should be treated at once. Carious bone should be removed. If it arises from a wound, this should at once be irrigated with a solution of 1:1000 bichloride of mercury. All dead material should be immediately removed. The disease seems to be generally caused by the staphylococcus pyogenes aureus. Antistreptococcic serum is of no use. We must depend upon nourishing diet and support of the patient. If he resists the onset of the disease and the preliminary abscess formation, it is possible that he can be built up and the system enabled to get rid of the pus.

#### Wound Diphtheria.

Wound diphtheria is maintained by some to be a form of hospital gangrene. It may be due to the Klebs-Loeffler bacillus or

pyogenic cocci. In any case, it usually occurs in ill-nourished people or where there is some lesion which markedly devitalizes the tissues, permitting the entrance of the organisms with very little resistance. The wound looks unhealthy and is coated over with a membrane, which in some cases is quite thick and tough. The membrane is composed of a fibrinous mass, in which there are generally dead granulation tissue cells and leukocytes, together with numerous chains and colonies of pus micro-organisms and perhaps diphtheria bacilli. If the membrane is pulled off it leaves a bleeding surface. The onset of the disease is sudden. The wound quickly takes on an unhealthy appearance, the temperature rises, and the other constitutional symptoms are quite marked. The patient does badly. Rigid antisepsis and cleanliness are demanded at once. The wound should be thoroughly irrigated with a strong antiseptic solution and the patient given a nourishing and stimulating diet. All the secretions must be kept active by appropriate treatments. The disease arises most frequently in unsanitary surroundings, ill-nourished people, and poorly ventilated quarters surrounded with filth. Under good hygienic conditions, if the patient has reasonably good health, the prognosis should be favorable, but in diabetic or rheumatic conditions, or in alcoholics, the prognosis is unfavorable.

### Erysipelas.

Erysipelas is an acute, diffuse, infective inflammation (lymphangitis) of the skin and subcutaneous tissues produced by the streptococcus erysipelatis (Fehleisen.) A wound or abrasion of the skin is also necessary for the entrance of the organism. In the description of idiopathic erysipelas by older writers it was said to arise from no particular cause. Such a disease does not exist. In facial erysipelas it is believed the organism often gets into the tissues through abrasions of the nasal mucous membranes. The contagion is likely conveyed by the air or water or the instruments or imperfectly sterilized dressings or ligatures. The morphology and characteristics of the streptococcus erysipelas do not differ from the streptococcus pyogenes, which produces diffuse pus formation. The clinical course of the case depends upon the condition of the tissues and the rapidity of infection and the virulence of the germs.

**General Pathology.**—When the virus effects an entrance into the tissues, it increases and multiplies rapidly and spreads quickly through the lymphatics and connective tissue spaces. The germ is found only, or at least in greatest abundance, along the margins of the inflamed area. If incisions are made through the skin, the serum which exudes will contain large numbers of the micro-organisms, whereas, in the center of the erysipelatous area there are no germs. Apparently the tissues have either gained mastery over the micro-organisms through the agency of the connective-tissue cells and the leukocytes or the germs have exhausted their food materials. At any rate, the germs continue spreading until their progress is arrested

by the combined efforts of all the tissues to rid themselves of this invading enemy. The constitutional symptoms of the disease are produced by the poisons being carried into the general circulation by the lymphatics. Now and then, where the inflammation is extremely severe, it is accompanied by exudations of serum beneath the epidermis, producing blebs or blisters. Sometimes the inflammation will extend into the larynx, producing edema of the glottis, or through the cribriform plate of the ethmoid into the brain, producing meningitis. It may produce middle ear disease and infect the lateral sinus, meningitis or abscess of the brain following.

**Classification.**—Erysipelas has been classified by writers generally into (1) simple or cutaneous, (2) cellulose-cutaneous or phlegmonous, and (3) cellular, which form is similar to acute diffuse cellulitis. Erysipelas is sometimes accompanied by pus formation, but not very often. This rarely, if ever, happens in the simple variety.

**Signs and Symptoms.**—(A) Local and (B) General.

**Local Symptoms**—Inasmuch as the pathology of the disease is that of an effective inflammation, the local symptoms are also similar. The patient complains of a burning or stinging pain, with stiffness of the tissues. The area is a rose-red, which in the majority of cases after a time changes into a dusky hue. The skin has a leathery feel and is hot to the touch. Generally the inflamed area presents sharply defined edges which fade into the healthy skin. These spread irregularly, frequently in the direction of the lymphatics, and in severe cases the edges of the inflamed area are forked. The lymphatic glands in the neighborhood are swollen, turgid, and painful. The inflammation may spread now in this direction, now in that, subside here and arise at another point. This previously has been looked upon as one of the whims of the disease, it choosing an erratic course, but this is explained by bony or muscular lesions. The inflamed area may be slightly or considerably raised above the surrounding tissues. If the inflammation is severe and exists about the eye, scrotum, or other location where there is an abundance of loose connective tissue, edema may be a marked symptom.

**General Symptoms.**—Previous malaise is followed by a distinct chill and a rapid rise in temperature. This chill generally precedes the inflammation from twelve to twenty-four hours. The temperature is high, according to the severity of the attack. In some cases it may be 103 degrees F. and in others 105 degrees F. At first there is more or less loss of appetite, the secretions are generally affected, and as the disease becomes more severe, there may be constipation. The urine is less in amount and highly-colored, tongue coated, breath foul, together with more or less muscular soreness and weakness. In debilitated states where the infection is rapid and the disease becomes progressively worse, the patient may enter a typhoid state, attended with high fever, albuminuria, and delirium. The pulse is generally very rapid and often

in mild cases of facial erysipelas the pulse may be 120 or 130, with but a slight rise of temperature.

**Varieties.—**

1. Migratory or wandering erysipelas is a form where it spreads widely over the body.

2. Bullous erysipelas is a form where the inflamed area is covered with blebs or blisters.

3. Metastatic erysipelas is a form where it leaves one part of the body and appears at another or appears on more than one place simultaneously.

4. Erythematous erysipelas is a mild form of cutaneous erysipelas where a red blush spreads over a certain area.

5. Erysipelas neonatorum is a term applied to erysipelas from an unhealed navel in the new-born.

6. Typhoid erysipelas is a form arising in adynamic conditions in alcoholics and diabetics and is attended by grave symptoms.

7. Edematous erysipelas where it is accompanied by marked edema of the skin. Sometimes the edema may be enormous.

8. Phlegmonous erysipelas is a variety where pus formation occurs.

9. Mucous erysipelas, a form which affects the mucous membranes.

10. Venous erysipelas is a term applied where there is marked venous congestion.

11. Lymphatic erysipelas is a term applied to certain cases where the inflammation is mostly confined apparently to the lymphatic channels, showing red lines in various directions.

**Clinical Course.**—The clinical course of the disease will depend upon the tissues affected. In simple erysipelas the inflamed area desquamates after the disease subsides. The disease may subside abruptly, which may be explained by the fact that the obstruction has been overcome and the circulation freed. The termination of simple erysipelas is generally favorable, as it readily responds to treatment. The parts may be weak for a long time after the disease subsides. In phlegmonous erysipelas, which is accompanied by abscess formation, the affected area is generally boggy and edematous and the redness is changed to a dark purple. Many times blebs appear filled with blood stained serum. The swelling is brawny. Just before pus formation happens, secondary chills occur. Sometimes instead of abscess formation there will be a sloughing of a patch of the tissues, leaving a ragged, ugly, and unhealthy sore. Often upon opening the abscess, the tissues, after the pus is evacuated, will present a white, stringy appearance. Repeated abscess formation may happen. Certain other diseases may set up, such as broncho-pneumonia, septicemia, pyemia, etc., when death generally follows. The severer forms of erysipelas are most fatal in case of chronic kidney disease. Phlegmonous erysipelas may often cause destruction of bone. In cellular erysipelas or diffuse cellulitis, the disease spreads through the planes of connective tis-

sue around the muscles and blood-vessels and may be attended by sphacelus or gangrene of a considerable area. The prognosis in these cases is not favorable.

**Treatment.**—Erysipelas is wrongly divided into idiopathic and traumatic by most authors. Trauma is responsible for all cases of erysipelas. It matters not whether the injury be external or some interference to the blood flow leading to such an amount of stasis as to deteriorate the resisting power of the organism, the result is the same. There must be some injury producing the conditions favorable for the growth of the germ. We know there are many organisms daily taken into the body which are capable of producing disease, but they are destroyed by agencies within, so that any cause which leads to the obstruction of the circulation through a part, the condition is then existing which favors the multiplication of the organisms, hence disease. In case of erysipelas the favorite site is the face, beginning at the upper part of the nose. It is usually found that some obstruction to the facial vein exists, e. g., at its junction with the jugular. Relief of this obstruction at once removes the condition upon which depends the possibility of the disorder continuing. In this case nature has cured the patient just as soon as given the power to act. The osteopath must be sure that the venous channels are free from obstruction and endeavor to flush the arterial blood to that part, as healthy blood is the greatest germicide. It must be remembered that while we handle a case of erysipelas with perfect immunity to ourselves, we may readily carry the organisms on our hands or clothing; it therefore behooves all who attend such cases to be scrupulously clean, especially so the one who does surgical and obstetrical work. Our experience with erysipelas has been sufficient to satisfy ourselves that all cases are handled successfully by osteopathic treatment. I do not at the present time recall a case in which we were not able to give relief in a very short time, and in most cases immediately. The treatment of such cases of course must be governed according to the location of the disease, as there is nothing to go by, and each case must be an individual one. If it is erysipelas around the face it is a facial disturbance, and if some other location it is a disturbance at that point. Erysipelas is nothing more than the blood being held in a place until it decomposes and it is nature's effort to dispose of it that causes the spread. It is a condition of a low grade of life coming immediately upon death of some structure. I have seen cases of chronic erysipelas, that have been of as long standing as seven or eight years, relieved by setting a partially dislocated angle of the jaw. I have seen cases of erysipelas in the leg caused by an interference at the saphenous opening or a twist of the hip which caused contraction of some of the muscles at that point. On some occasions the limb may be swollen to twice its natural size, when after the first treatment it will be reduced to almost normal within twenty-four hours. Osteopathic treatment should cure all cases, and if not, it is on account of the in-

ability of the practitioner in locating the cause. Great stress should be placed on the examination, and if the cause is found there is no reason why the effect cannot be relieved. Pulling teeth is a common cause of dislocating the jaw. Inasmuch as effect follows cause within the system, when the cause is removed the effect disappears, therefore it is the duty of the physician to locate and remove the obstruction. Abscess formation demands evacuation of the pus and the enforcement of rigid asepsis.

### Tetanus.

Tetanus is a toxemia accompanied by more or less tonic spasm of the voluntary muscles, beginning in the muscles of mastication and gradually extending into the muscles of the back and extremities, finally involving nearly the entire muscular system. These more or less tonic spasms are attended with clonic exacerbations. The toxemia arises from the infection of a wound by the bacillus tetani (Nicolaiier). The disease is much more common in hot climates and among the negro race. It is said that in Jamaica one-fourth of the new born negroes succumb to tetanus. The disease is likewise more common in men than in women, also in military than in civil practice. The germ produces the most exquisitely toxic substance known. The toxin circulating through the body seems to have an affinity for the nerve tissues. It produces marked congestion and inflammation of the gray matter of the spinal cord. The germ is found extensively throughout nature, especially is it found in dust, garden earth, manure and about stables. It is more common in some kinds of earth than others and in some countries than in others. In the islands of the New Hebrides the natives poison their arrows by dipping them in clay containing large numbers of tetanus bacilli. The wound in which infection takes place may be small or large, may vary from a pin scratch to a capital operation. It may happen at the stump of the umbilical cord in the new born child. It may arise from abrasions of the intestines, as the germ is frequently found in the contents of the intestines of animals. The so-called idiopathic tetanus likely arises from infection of a small wound in the mucous membrane of the intestines. Tetanus infection is especially common after lacerated or punctured wounds and burns. It has been observed that infection is more common when there is suppuration. This has been explained by the fact that the micro-organisms of suppuration use up the oxygen and as the tetanus bacillus is a saprophyte, it makes the conditions for its growth more favorable. Tetanus may be inoculated from animal to animal or from animal to man. Deaths have occurred in persons who have sustained small wounds in holding an autopsy on an animal which died of tetanus. Exposure to cold and sudden changes in temperature seem to predispose to tetanus. This observation may have been made because of the fact that the premonitory symptom of the disease is generally that of stiffness of the muscles, which the patient often attributes to cold or exposure. It has

been advocated that since the germ does not circulate within the body and lies in the tissues adjacent to the wound, that to remove the tissues would be a successful way to get rid of the poison. This has led to the observation that the poison is in the nature of a ferment and after the symptoms of the disease have appeared, if all the germs were removed, death would follow just as quickly. The poison, because it is of the nature of a ferment, sets up such destructive changes in the tissues that death results. Before the days of asepsis and antisepsis, tetanus caused the death of many patients undergoing surgical operations. It is said that a famous surgeon lost ten successive cases by lock-jaw following major operations, when he accidentally discovered his instruments were the source of infection, and having boiled these he lost no more cases. Illustrating how readily this disease may be transmitted from animal to man, the terrible, unfortunate, and fatal experience of the city of St. Louis, Mo., in the manufacture of the diphtheritic antitoxin shows how, by negligence, the poison could be dispensed with the diphtheritic antitoxin and injected into the diphtheria cases, producing death by tetanus. More than a dozen deaths resulted from the injection of the infected diphtheritic serum.

**Pathology.**—The pathology of the disease seems to be that of a toxemia, as proved in the cases of death happening as before mentioned in St. Louis. The germ is not necessary to the production of the disease, but the toxin only may be injected into the system and all the disease symptoms produced. The germ, if it gets into the tissues at all, stays in the margins of the wound and is more virulent when associated with the common bacillus of the colon and with the pus micro-organisms. The germ is found about horses, in horse stables, in manure, and in decomposing substances, hence wounds by a rusty nail or cut sustained in such localities should be carefully cleansed with an antiseptic solution. The opinion held by the laity that the disease is caused by pain is erroneous. The disease only happens after infection by the above named germ. The disease may be simulated by muscular contractions from other causes and these may be thought to be tetanus, but are not. The poison is eliminated, to a considerable extent, by the urine. The period of incubation of the disease is usually about five days, but varies from twenty-four hours to two or three weeks, and in some cases even longer.

**Symptoms.**—In the beginning the patient believes he has caught cold and has stiffness of the muscles. This stiffness is most pronounced in the muscles of mastication. The patient is unable to open his mouth widely and complains of a soreness in his throat and of the muscles of his neck. Acute tetanus comes on within ten days, the usual period being from three to five days. The muscles of deglutition and of the back, arms, legs, and abdomen become at first stiff and are then thrown into a tonic spasm. The part of the body upon which the wound occurs also shows stiffness and tonic spasm. This spasm finally extends to

the facial muscles and causes a spasm of the risorius (Santorini) muscle, the corners of the mouth are pulled up and the patient's face presents a horrible grinning expression (risus sardonicus). Often the contractions of the muscles of the back are sufficiently strong that the patient will lie upon his head and heels, the spine being markedly curved by the contraction of the erector spinae mass (opisthotonos). Sometimes the contraction is most manifest in the muscles of the side of the body and chest, when the person is turned to one side (pleurothotonos), while if the anterior muscles are affected the body and head will be drawn forward between the legs (emprosthotonos). The spasms are exaggerated by external irritation. The creaking of a door or jarring of the bed upon which the patient is lying will cause exacerbation of the spasms. The contractions of the muscles of the jaw may be severe enough to produce fracture, the teeth may be broken off and where the muscular spasm affects the upper extremities the finger nails may be buried in the palm. The mouth is sometimes covered with bloody froth due to the fact that the person has bitten off a piece of his tongue. The face expresses terrible suffering. The person is conscious until the last. The muscles of respiration are frequently affected, causing dyspnea. Sometimes the muscles of the glottis are affected, causing obstruction to the ingress and egress of air. While an interne in a metropolitan hospital the writer saw a prominent surgeon do a tracheotomy "in an unrecognized case of tetanus" to relieve strangulation because of spasm of the muscles of the larynx. Sometimes the person suffers from an agonizing girdle pain due to the implication of the diaphragm. The patient is severely constipated during the disease because of the contraction of the sphincters. Swallowing is almost impossible, and talking is difficult. The temperature may be normal, but is generally very high. Cases are reported where the temperature has attained a height of 111 degrees F. The person suffers from insomnia because of the muscular spasms. Death is due to exhaustion and narcosis from carbonic acid poisoning, because of the spasms of the respiratory muscles.

**Varieties.**—Clinically there are several forms of the disease recognized, viz.:

1. Idiopathic tetanus, described by old writers, is now known to arise from wounds.
2. Tetanus neonatorum occurs in new-born infants from the infected stump of the umbilical cord.
3. Puerperal tetanus from infection of a woman at the lying-in period.
4. Cephalic tetanus, resulting from wounds in the head and accompanied by facial paralysis.
5. Acute tetanus comes on early and is attended by great severity of the symptoms.

6. Chronic tetanus comes on late and successively involves different parts of the body and may extend over a long period of time.

The mortality in all forms of tetanus is about 50 per cent.; in the acute form 80 to 90 per cent. and in the chronic form about 20 per cent.

**Diagnosis.**—The diagnosis of tetanus is apparently easy. It must be differentiated from strychnin poisoning, hydrophobia, and hysteria. Strychnin poisoning begins with exhilaration and restlessness. The senses are for a time sharpened. The muscular symptoms develop rapidly and generally commence in the extremities. Sometimes it affects the whole body simultaneously, especially if the dose is large. The jaw is the last part of the body to be affected. If the convulsions are very severe the jaw may be set, but after the convulsion it drops. In strychnia there is muscular relaxation between convulsions, the patient is excited and sweats. If there is recovery the convulsions become less frequent and less severe. Consciousness is preserved during the convulsions. "The slightest breath of air" will produce a convulsion. The patient may cry out with pain, but his cries are only momentary and express fear and apprehension of the spasm. The eyes are stretched and wide-open, the legs extended and the feet turned out.

In hysteria there is often a history of globus hystericus. Muscular rigidity begins in the neck and spreads over the body. The patient generally persists in opisthotonos and muscular rigidity between the convulsions. Consciousness is usually lost and the eyes are closed. Crying spells often alternate the contractions. There is often a history of a neurosis in hysterical spasms. There may be an immense quantity of urine excreted, or urination may be frequent or suppressed.

In tetanus the disease begins with pain, stiffness of the jaw, produced not from pain (as tetany may be), but because of the toxemia. This stiffness gradually extends to the muscles of the back, thorax, and the lower extremities. It may affect the facial muscles and muscles of the upper extremities. The muscles of the neck and back become hard and rigid like iron, at no time relaxing. These tonic contractions are exacerbated by certain clonic spasms; drafts of air, loud noises, light, shaking of the bed, swallowing fluids, visceral actions, etc., bring on the spasms. In hysteria the spasms come on without cause, and sometimes are associated with the choice of the patient.

**Treatment.**—The treatment of tetanus consists of preventive and curative.

The preventive treatment is careful antisepsis. Aseptic and antiseptic methods in surgical operations will eliminate this complication in operative procedures. As soon as the disease appears the wound should be cleansed with 1:500 solution of bichloride of mercury, the patient kept in a dark, well ventilated room and should have absolute quietude, not even being exposed to drafts of air or rays of light. If the urine is retained it should be withdrawn by a catheter. If the bowels refuse to move, enemata should be given of soap-suds or castor oil.

After the bowel is cleaned out, the patient being unable to swallow, predigested food should be injected into the rectum. The patient should be fed regularly and supported, every effort being made to prevent a recurrence of spasms. Bromide of potassium in gram doses every three to six hours has been advised, but the writer has failed to observe where the administration of this drug was attended by favorable results. Other drugs, such as the application and use of alcohol, fomentations of tobacco, anesthetics, etc., have been used. So far there seems to be no remedy for the cure of tetanus. It remains to be proven whether an antitoxin can be developed which will effect a cure. The antitoxin serum of Tizzoni is said to be little short of useless. In chronic cases the antitoxin may be of value. Some recommend hypodermic injections of iodoform, three to five grains, three times a day. This treatment is valueless. If death does not occur before the ninth day the patient may be said to have a fair chance of recovering. Acute tetanus generally kills before that time. Osteopathic treatment consists in securing muscular relaxation and relieving the spasms whenever they appear.

#### Hydrophobia.

Hydrophobia is an acute specific toxemia, most common in the dog, wolf, cat, and skunk. It is said by some to have occasionally occurred in poultry. It may be transmitted to horses, cattle, and other animals, and often to man. The saliva of the affected animal seems to be the vehicle by which the poison is transmitted, consequently if the bite is through clothing the disease is less likely to follow than when the injury is on some exposed part of the body. No micro-organism has ever yet been discovered to which this disease may be attributed. The peculiarities of the affection leave little or no doubt in the minds of bacteriologists that one exists, and it is thought if there is a specific micro-organism that it is present in the saliva. It is believed the micro-organism flourishes in the tissues about the wound and that its growth and development result in the production of a toxin which affects the central nervous system. The masses of gray matter in the medulla, cerebral hemispheres, and the pia mater are markedly congested, causing the peculiar symptoms of the disease. The varying period of incubation has caused serious doubts to arise in the minds of many physicians as to whether the disease, *rabies* or *lyssa*, as it is sometimes called, actually exists. The period of incubation varies from a few days to twelve months. The average duration is said to be six weeks. Only about 14 per cent. of the bites of supposedly-rabid dogs result in the production of the disease in man. This is perhaps due to the fact that the bite very often takes place through clothing. It is said that bites on exposed parts are productive of the disease in 60 to 80 per cent. of the cases. Inasmuch as nothing can be done in the way of treatment, it is necessary to recognize the disease in the animal and prevent infection. Hydrophobia is not so common in this country as it

is in Europe. In central Russia, where there are many wolves, the disease is quite common. The animal when affected begins to droop, shuns the light and is restless. The disease manifests itself in two forms, one a furious form, where there is marked frenzy and madness. The symptoms after the preliminary drooping condition are alarmingly dangerous. The animal is insensible to pain and its taste is perverted so that it eats sticks, hay, and any objects it meets. Oftentimes on autopsy, if the stomach shows such foreign bodies or objects, it is safe to make a diagnosis of hydrophobia. There is a profuse secretion of ropy, sometimes frothy, mucus. Soon there is paralysis of deglutition, spasms of the muscles of the larynx and pharynx and the bark is changed. Respiration is rapid and the pupils dilated. The animal trembles and runs about wildly, madly biting everything with which it comes in contact.

The other is a paralytic form where the subject is quiet and the lower jaw becomes paralyzed early and drops down and the tongue hangs out of the mouth. If the animal is "suspicious" it should be kept under surveillance. If the animal has bitten another animal or a person, they should be kept under surveillance until it is determined whether they have the disease. If they have, the animal should be killed at once.

The symptoms in man are first respiratory. There is rapid respiration and more or less halting speech. The person becomes melancholic and anxious and shows great despair. Deglutition is interfered with because of reflex spasms. The word "Hydrophobia" indicates that the subject fears water, but this is not true. Any irritation of the throat will set up a reflex spasm of the pharynx and larynx, causing more or less suffocation. There is great palpitation of the heart and sometimes a breath of air will precipitate a paroxysm. The paroxysms are often furious, the delirium wild and muttering, and during the spasms of the muscles of the larynx the voice is hoarse and unnatural and oftentimes somewhat resembles the bark of an animal. There is great muscular tremor, followed by paralysis and death. The medulla and hemispheres of the brain, as before mentioned, seem to be the parts affected, together with certain areas of gray matter in the spinal cord. Hyperemia seems to take place, largely in the adventitious tissues of the nervous system. There are very often hallucinations during the disease. In the paralytic form the person has preliminary mental anxiety, and great depression and despair. The muscles of mastication become paralyzed, the lower jaw drops, the tongue hangs out of the mouth and the person looks haggard and wild. Paralytic symptoms supervene. The wound generally heals and the person may have forgotten about it, but at the time when the disease appears the scar becomes inflamed and congested.

**Treatment.**—No drugs seem to have any effect upon the disease, hence when the wound is made it should at once be relieved of infec-

tion. This can best be done, first, by thorough and exhaustive suction to remove the virus; second, cupping; third, the wound should be enlarged and allowed to bleed freely. Lastly, it should be washed out with an antiseptic solution or cauterized with carbolic acid. If the wound has not been immediately treated and it is believed that the animal is mad, emulsions should be made of the central nervous system of the animal and this injected into rabbits to determine whether or not the animal was the subject of hydrophobia. This will require three or four weeks' time, so it is essential to determine, if possible, whether or not the animal has hydrophobia without such experiment, since it delays treatment. The best treatment seems to be that administered by the Pasteur institutes, which is done by means of injecting within the tissues of an animal attenuated virus until the subject becomes immune, then emulsions are made from the spinal cord of this immune animal and this is injected into the subject thought to be infected. The treatment is said to be successful. Mad-stones, which have efficacy according to the beliefs in the minds of people, are of course one of the monstrous fallacious fancies handed down from generation to generation. The disease is always fatal when not treated.

#### Malignant Pustule.

Malignant pustule is sometimes called "Wool sorter's disease," inasmuch as it is generally contracted by the handling of wool or hides from infected sheep. The cause of the disease is the anthrax bacillus. The disease is not so common in this country as it is abroad. The incubation period appears to be two or three days. The disease generally appears on the face, hands, or arms and is first manifest by a little papule, after which follows a small vesicle. This enlarges and a mass of the tissues dies. The papule is indurated and inflamed, but there is no pain. Necrosis is manifest by the fact that a small patch turns black and sloughs out, leaving a ragged hole. Sometimes where there are several points of infection it may resemble a bad carbuncle. Sometimes the infection is pretty general on the body and may extend into the viscera, when death will result. The anthrax bacillus is extremely virulent and infectious, hence should be handled with great care. Where the case is seen early the prognosis is generally favorable.

**Treatment.**—The treatment is first local, by cautery. The entire sore should be burned out by means of a thermal cautery or by means of fuming nitric acid or carbolic acid and then the part treated in an antiseptic manner. The general treatment consists of cleanliness and support. After the necrosed area sloughs away the ulcer should be washed out twice daily with an antiseptic solution, 1:1000 bichloride of mercury, and boracic acid dusted over the sore. Then several layers of antiseptic gauze and cotton should be applied and held firmly by suitable bandage.

### Actinomycosis.

This disease is rare in man. It is most common in cattle, where it is called "lumpy jaw" or "swelled head." The cause of the disease is the ray fungus. This consists of long, irregular, club-shaped prolongations which radiate from a common center. The infection is acquired by man from some of the lower animals. It is generally accompanied by pus formation and the pus is peculiar in that it contains yellowish gritty particles. The disease is more common on the face and neck and may involve the jaw, the pharynx and even the larynx, producing multiple abscess formation. It may also involve the bones and glands. The *diagnosis* can be made by the history of the case, by small yellow particles in the pus, and lastly by the microscope. The *treatment* is extirpation of the infected area.

### Tuberculosis.

Tuberculosis is an infective disorder, characterized by its slow course and the formation of granulomatous masses. The cause of the disease is the bacillus tuberculosis (Koch), which varies in size from 1.5 to 3.5 mikrons long, and from .2 to .5 mikron broad. The rod-shaped organisms are very often undilated or beaded, lying parallel or with the ends of the bacilli closely approximated. The tubercle bacillus will affect any of the tissues of the body, and in fact almost all warm blooded animals. Cold blooded animals are less susceptible, but they may often contract it. That it is the cause of most of the processes called tubercular, is a fact beyond dispute, but there are many conditions which are called tubercular, simply because of the chronicity of the course and because the disease refuses to abate.

The *source of infection* to man lies in the dust particles in the air, in the food supply, and in the water. The germ resists drying, hence it may readily be carried through the air, where it gets into clothing, when it may infect the skin, or it may be breathed in, picked up by some leukocyte and carried to other parts of the body, where it may be lodged and set up the disease. The germ is readily found on articles of furniture, in carpets, in the dust, and on the walls of the apartments of a tubercular patient. Its infection is rather mild, but after infection takes place it is extremely fatal.

**Pathology.**—The characteristic lesions caused by the tubercle bacillus are simply small nodules or tubercles. These small nodules have been variously described, but consist for the most part of a central area in which there is a giant cell, containing one or more of the germs, around which there is an area of what are termed "epitheloid" cells, which seem to be derivatives of the resident connective tissue cells. These giant cells are said by some to be the result of fusion together of more or less wounded or destroyed connective-tissue cells; by others that their vitality is largely destroyed by the presence of the tubercle bacillus and the cell is unable to divide, that the nucleus divides without the cell dividing, somewhat resembling an endogenous form of cell

division. Around this there is a peripheral zone of leukocytes or round-cells. This forms a mass about the size of a millet seed or mustard seed. Several of these tubercles may be near each other and fuse together, making a larger mass. These tubercles are avascular, and the cells crowding in closely, more or less cut off the nutrition to the central area, when the mass dies and undergoes coagulation necrosis. Sometimes pus is formed, sometimes not. Even if pus is formed the fluids may be absorbed and the residuum undergoes caseation or may become calcified, forming a hard calcareous mass which may lie latent in the body for many years. It may undergo caseation with the tubercle still present, the mass being surrounded by an inflammatory area, the leukocytes having built up a solid wall or cordon, preventing the bacillus from getting into the fluids of the body. This may exist for years, finally, because the body becomes generally debilitated, the tissues inactive, and the resistance diminished, the germ takes on renewed activity and the patient develops acute tuberculosis. As before mentioned, the case is generally chronic, but it may run a rapid course. The writer once treated a man who had taken a large dose of laudanum because of a love affair. He recovered fairly well from the opium poisoning, but this seemed to have so weakened the system that it made him a suitable prey for the tubercle bacilli which were present in quiescent Pott's disease of the spine. This disease had been quiet for a number of years and the man enjoyed good health and had worked at hard labor. After recovering from the opium poisoning he contracted tuberculosis and died on the eleventh day, after taking the opium, of acute miliary tuberculosis. The germs, as before stated, lie in the center of the tubercle and because of the resistance of the surrounding tissues are kept imprisoned there. Some venturesome leukocyte attacks one of the germs and carries it away into the lymph spaces, only to fall a prey to its prisoner. Then the bacillus is transported by the lymph into the general circulation and perhaps into the distant tissues. The edge of the tubercular zone, or the zone of lymphoid cells, presents a characteristic inflammatory reaction. As before indicated, the tubercle bacillus may be walled up within the nodular mass and may remain there quiescent for a number of years. In some cases the germs may be entirely destroyed and almost all evidence of the tubercular inflammation removed by the absorbents. It is peculiar of tuberculosis that there is little tendency to recovery; that the cells developed fall short of maturity.

**Changes in the Tubercle.**—The changes following the deposit of the tubercle in the tissues are:—(1) Absorption of the bacillus and its consequent destruction, wherein there is no appreciable pathological change. (2) Caseation. (3) Fibrosis (Encapsulation). (4) Calcification. (5) Pus formation.

In caseation the tissues undergo coagulation necrosis. True pus is not formed, or if it is formed the liquid elements are absorbed and the

mass undergoes cheesy degeneration and forms a cheesy mass. This may later become calcified, or the epitheloid cells which are about the dead mass may become converted into spindle-shaped cells of fibrous tissue, when a hard fibrous wall is formed about the tubercle bacilli. This is the condition of "fibrosis." Calcareous materials may be deposited in this fibrous tissue or the cheesy mass may be converted into a calcareous mass by the deposit of lime salts, when it is said to undergo calcification. Now and then in tuberculosis subjects these calcareous masses or gritty particles may be expectorated. A substance quite akin to pus may be formed, but true or characteristic pus is rarely, if ever, formed unless there is infection by means of the pyogenic micro-organisms in addition to the tubercle bacillus. This sometimes happens. The pus in tuberculosis is more like that of a chronic abscess, and in fact they so closely resemble each other that some writers have held that all chronic abscesses are tubercular, which opinion is unwarranted.

**Causes.**—(A) Predisposing. (B) Exciting.

The *predisposing causes* of tuberculosis are (1) heredity. By heredity is meant, not the direct transmission of the disease from the mother or father to the child, as may happen in syphilis, but a tendency towards the disease is inherited so that children of consumptive parents are more prone to the disease than children born of healthy parents.

(2) Strumous diathesis, which means a condition in which there is a general tendency to the enlargement of the lymphatics and the production of adenoid tissue.

(3) Bad hygienic surroundings. The disease happens in persons who have not had sufficient out-door exercise and who breathe air of poorly-ventilated rooms. The tissues become devitalized and weakened and permit the bacillus to gain a foot-hold. More important than all these predisposing causes, and perhaps the actual cause in chronic conditions where the tubercle bacillus can not be found, may be stated *Osteopathic Lesions*.

(4) Osteopathic lesions. In all forms of infection osteopathic lesions are of the utmost importance. That a part may not receive its proper blood supply and proper nerve supply is a fact too well known to be disputed. It is generally known that disuse of a part causes a weakening; furthermore, that when a bone assumes an abnormal position, which it frequently does, it interferes with the blood supply to a certain area, also presses upon the nerves so it interferes with the trophic influence. Other things being equal, the point to which these compressed nerves and arteries are distributed would be weakest. Now the fact that such lesions make tubercular infection possible can not be disputed. Furthermore, the irritation set up by the abnormal condition of the bony framework of the body brings about muscular contraction. This interferes markedly with the circulation, rendering weaker the parts to which the compressed arteries are distributed. Collateral circulation in some cases may be thoroughly established, but in other cases this may be

impossible, when then the part receives a small injury, inadequate to produce the disease under ordinary circumstances, yet in this weakened state inflammations are set up and a condition of the tissues suitable for the development of the germs is produced. This injury, and nearly always a history of one can be obtained, is of more importance than has generally been considered, for most likely it very often results in conditions of subluxation and contractions of muscles, fascia, ligaments, etc., interfering with the normal blood and nerve supply to the part, so that the lesions found may be at the joint affected or there may be spinal lesion affecting the structures upon the side of the body below. Very often the treatment of this spinal lesion will be attended by a cessation of the disease symptoms in some distant part. This happens when the spinal lesion has been the chief predisposing cause of the disease. The importance of this must not be under-estimated. Under all circumstances an eager and thorough search should be made for the above named causes.

The *exciting cause* is the *Bacillus tuberculosis*. It enters the body in many ways, through the air, food or drink, or may enter through the skin. They become disseminated in the following manner: (1) In conditions of lupus and anatomical tuberculosis the disease seems to be confined to one spot and spreads only by the extension of the inflammation of the skin, not affecting the connective tissues and muscles and lymphatic glands beyond to any great extent.

(2) They may spread to the lymphatic glands, where they excite inflammation.

(3) They may enter the lymphatic or hemic circulation and lodge in some distant organ where the characteristic tubercle is found. The tubercle bacillus seems to have an affinity for serous membranes. The organs most prone to be affected are the lungs. Next in frequency are the testicle, kidney, brain, liver, spleen, adrenals, ovaries, mucous membranes of the larynx and intestines. Bones and joints are affected in the following order of frequency: Hip-joint, knee-joint, joints of the ankle, foot, hand, and elbow, while the shoulder and collar bone are rarely affected; the scapula, ilium, and bodies of the vertebrae may be affected. The skin is affected less frequently than many other tissues. The inflammation is set up by apparently slight causes and is progressive, indolent and chronic in its nature, and has little tendency to recovery.

#### Tubercular Abscess.

The most important termination of the tubercular process is a cold abscess. It has the characteristics of an ordinary chronic abscess. There is present little inflammation. The symptoms of inflammation may be almost entirely absent. The most characteristic point about the cold abscess is its limiting membrane. This was formerly called a *pyogenic membrane*, as was the membrane lining an ordinary abscess.

cavity. This limiting membrane is a defence-wall, built up by the tissues to prevent absorption of micro-organisms and the products of the decomposition and disorganization of the tissues. Strange to say, the tubercle bacilli are rarely, if ever, found in the contents of a cold abscess. It is said they exist in the margins of the limiting membrane. As a general rule the abscess causes but little trouble until it ruptures, when pyogenic infection follows, causing a severe systemic reaction. The abscess may gravitate and open at a distant point. It may exist for months, the fluid contents being finally absorbed. The solid residuum afterwards undergoes cheesy or calcareous degeneration. The common forms of these abscesses are gravitation abscess, psoas abscess, retropharyngeal abscess, lumbar abscess, etc., which will be discussed elsewhere.

#### Tubercular Gummata.

Tuberculosis is an infectious granulomatous disease similar to syphilis, leprosy, and glanders, so that the formation of gumma, as happens in these other diseases, may happen in tuberculosis. Gumma consists of a fusing together of tubercles which have undergone degeneration, together with a large mass of ill-formed and ill-developed granulation tissue cells. It consists of a mass of fungus granulations which readily break down and ulcerate. They happen in the cranial and peritoneal cavities least often, but are common in bones and joints. The gumma consists of a mass of condensed tissues, often uninfected. It has a poor blood supply and a tendency to break down and ulcerate.

#### Scrofula.

Scrofula is not a disease, but a condition of the system whereby the tissues become an inviting host to the tubercle bacillus. It is generally of congenital origin, one or the other of the parents being tubercular. The lymphatic glands are prone to enlarge and suppurate. Joints and bones are liable to be affected. Often there is a chronic catarrhal inflammation of the mucous membranes or chronic eye disease, granulated lids, etc., eczema of the scalp or face, all of which are evidences of bad health, malnutrition, etc. Generally the patient is a victim of unsanitary surroundings or poorly ventilated quarters.

#### Tuberculosis of Various Regions.

**Skin.**—(1) *Lupus* is tuberculosis of the skin. It usually happens upon the face, beginning before the age of twenty-five. The nose seems to be its choice point of origin. Three varieties are described. (a) *Lupus Vulgaris* is the most common form and appears as pink nodules, which ulcerate after a time and then cicatrize. This process of forming nodules, ulceration and cicatrization keeps up continuously, perhaps disappearing here, but appearing with renewed activity at another point. (b) *Lupus eredens* is characterized by severe ulceration. (c) *Lupus*

*hypertrophicus* is a form in which very large nodules appear. Lupus generally begins as a pimple, or group of pimples, which finally break down and ulcerate, leaving a soft irregular, not shelving, ulcer, which discharges a yellowish colored fluid. The bottom of the ulcer looks unhealthy and the skin about the ulcer is more or less inflamed. It is said the disease is painless, but sometimes it is extremely painful. It is not unusual that the ulcerating process may entirely heal up, but it finally recurs. It will heal up at one point and become more active at another, always destroying tissues over some part of the area. Cicatrization may have occurred, which will draw the surrounding tissues, often producing deformity. The process may be quite destructive, similar to a rodent ulcer, and produce hideous deformity. Scars produced by lupus are firm and hard, but yet break down easily. One of the characteristics of lupus is that the tuberculous secretions, drying, form yellowish crusts, often more or less scaly. Clinically it may be differentiated from a rodent ulcer, inasmuch as the rodent ulcer presents an everted appearance and is deep, while in the ulcer numerous vessels are visible. It does not spontaneously heal and its base and edges are hard and fibrous.

**Treatment.**—The best treatment for lupus is a free removal of the diseased tissues with a knife, curette, or cautery. If possible, the entire mass should be removed and the wound be made to heal by first intention. If the wound is allowed to heal by second intention, it is better that the cautery or curette be used. Where the curette is used, subsequent application of caustic, such as nitrate of silver or chloride of zinc (5 to 10 per cent.), or the electric cautery, may be made. After the cauterizing of the lupus the wound should be treated with an ointment of aristol. Concentrated electric or sunlight from which the heat rays have been removed seem to have given satisfactory results in some cases, but the treatment requires a long time, inasmuch as but a limited area can be exposed at a sitting. The result of the exposure to light is a sloughing out of the lupoid area.

(2) Anatomical Tubercle.—This lesion of the skin happens in surgeons or in operators holding post-mortems where infection takes place in wounds by means of tuberculous material. The anatomical tubercle is a red inflamed mass, often pustulating.

(3) Tubercular gummata.—Tubercular gummata of the skin are characterized by edematous inflammation and ulceration. The ulcers have grayish bases, show no tendency to heal and have inverted edges. Sometimes there is a chronic thickening of the skin, called sclero-derma.

**Subcutaneous Connective Tissues.**—In subcutaneous connective tissues the tubercular process is usually manifest in the form of cold abscess. It may be manifest by gummata and tubercular nodules.

**Lung.**—Pulmonary tuberculosis does not belong to the province of surgery and is best treated by well known osteopathic methods.

**Alimentary Canal.**—Tuberculosis of the mouth, pharynx, esophagus, stomach, and intestines is very rare. The germ may pass through the lining membranes of these cavities and set up inflammation in the deeper structures. The adenoid glands found in the mucous membranes of the intestines may become involved.

**Peritoneum and Pleura.**—Tuberculosis of these membranes becomes surgical only when abscesses are formed.

**Bone.**—Tuberculosis of bone is common in youth and is always preceded by injury. There exist osteopathic lesions which make the injured bone a point of least resistance. The deposit of the tubercle causes the characteristic inflammation, attended with softening of the bone and even of the production of an abscess. This calls for surgical intervention. (See necrosis of bone).

**Joints.**—Tuberculosis of joints is popularly termed "White Swelling" and consists of a chronic inflammation and degeneration of the synovial sac. Children are especially susceptible to the disease. It is brought about by injury and subluxation. The deposit of the tubercle may occur in the end of the bone, in the synovial sac or in the connective tissues just outside of the synovial sac or in the epiphyseal cartilage. Lesions affecting the circulation to the joint are responsible for the disease.

**Lymphatic Glands.**—Tuberculosis of lymphatic glands is known as "Tubercular Adenitis." The frequency with which enlargement of lymphatic glands occurs in tuberculosis is even popularly recognized. This enlargement is due to the fact that the inflammatory products and the tubercle bacillus are carried back through the lymph stream and lodge in the lymphatic glands. Caseation often occurs. Residual abscess may follow. Tubercular adenitis is more common in the neck and mesenteric glands, but may occur anywhere in the body. It may in some cases become very general. Suppuration arises from mixed infection. While the disease is generally local, it may become a source of infection, general tuberculosis following. It must not be confounded with lymph adenoma, which usually occurs in the lymphatics of the posterior triangles of the neck, whereas cervical lymphadenitis generally occurs in the anterior triangles of the neck. Tubercular glands very often run together and form a large inflamed mass. In every case obstruction to the local circulation may be noted, which is responsible for the inflammation.

**Testicle.**—Tuberculosis of the testicle is not rare. Generally but one testicle is affected in the beginning, but later both are affected. It is a form of painless epididymitis and orchitis. The tubercular mass many times softens and breaks down, forming an abscess which burrows towards the surface. The layers of the tunica vaginalis, the skin, and subcutaneous tissues become adherent and it may rupture externally. The diagnosis is made purely by the clinical facts presenting. The use of the microscope is of no avail, as the bacilli are not in the dis-

charge. In fact, it is not necessary to make the diagnosis of tuberculosis, for it does not modify the treatment.

**Prognosis.**—The prognosis varies with the condition of the patient, the structures involved, the extent of the infiltration and the rapidity of the process.

#### Treatment of Tuberculosis.

(1) Hygienic, dietary, and climatic. (2) Osteopathic. (3) Surgical.

Hygienic, dietary, and climatic treatment are of inestimable value in tuberculosis. The hygienic treatment consists chiefly in an open-air life in pleasant surroundings, etc. The chief dependence of the tuberculous patient seems to be in an appetite satisfied with wholesome and nourishing food. The patient should be instructed, if he has extensive tuberculosis, to eat less in amount and more frequently. The diet should consist of eggs, if they are well borne, from three to six daily, milk in large quantities, good steak, beans, rice, cereals, etc. If the person has lost his appetite, or if he has indigestion, predigested foods should be given, such as beef tea, prepared in the following manner: Place a piece of minced lean beef in a glass fruit jar which is then sealed up and put in a pan of water and gradually heated to boiling. The juice is decanted and the remaining liquid elements pressed from the beef. This juice may be seasoned to taste and is usually well borne and nourishing. Commercial beef tea is usually of not much value. Fruit juices are often well borne, encourage an appetite, and are pleasant.

**Climate.**—The pine covered hills of northern Georgia, the dry atmosphere of New Mexico, and the altitude of Colorado are all favorable to the health of tuberculosis patients. They encourage deep breathing, secure a better blood supply to the chest and cause the patient to do what he otherwise would not do, take more lung exercise.

The **Osteopathic Treatment** consists in increasing the blood supply to the affected area, adjusting vertebrae, ribs, clavicles, relaxing contracted muscles, etc., that may have excited or are aggravating the diseased conditions. Since our only hope of curing tuberculosis is in increasing the vitality and nutrition of the tissues, osteopathic treatment has this in view when it removes pressure from artery, vein or nerve or when it increases the blood supply to a part by means of stimulating the vasomotor nerves. It has been advocated by enemies of the practice of osteopathy that there is danger in manipulating a tubercular joint or area on account of scattering the germs and causing acute general tuberculosis. Clinical practice of the entire osteopathic profession in the enormous number of these cases treated shows that there is no such danger in this treatment properly applied. It is unnecessary to state here that drugs administered internally are of no value in the treatment of tuberculosis.

The *surgical treatment* consists in extirpating the tuberculous area

when it is accessible. Cold abscesses when opened should be thoroughly cleansed with a solution of bichloride of mercury (1:1000), then the abscess cavity should be scraped out and free drainage established. Iodoform emulsion in glycerin (10 parts iodoform to 90 parts glycerin) may be injected into the cavity, providing the drainage is good, after it has been thoroughly washed out with an antiseptic solution. The tuberculous area should be kept as nearly aseptic as possible and likewise at rest.

**Koch's Tuberculin.**—The specific treatment devised by Koch has been proven worthless and is no longer used.

Bier's method consists in placing an elastic band around the limb above the tuberculous area and is founded upon the principle of Laennec, that cyanosis was unfavorable to the tuberculous process. The elastic band causes venous congestion. Surgical interference should be advised only as a *dernier* resort, when it is shown that the condition can not be relieved by osteopathic treatment properly applied.

### Glanders.

Glanders is an infectious disease produced by the bacillus mallei. It manifests itself in acute and chronic forms. It is classified as one of the infectious granulomatous diseases, because of the granulomatous masses formed in the mucous membranes and in the skin and connective tissues at which points the micro-organisms have obtained entrance, or having gotten into the circulation, have lodged at these points and set up the characteristic pathological changes. The disease is common in the horse, but is rarely seen in man, and then only in laborers about stables. It is contracted by laborers about stables from the fact that the pus is blown into the face or onto the body, from which point it either gets into a small wound in the skin or it effects an entrance through the mucous membranes. In man the disease is characterized by (1) copious, foul, and sanious discharge from the nose, (2) an eruption over the body quite resembling small-pox, and (3) enlargement of the lymphatic glands with formation of nodes, which break down and ulcerate, forming foul ulcers, which discharge a disagreeable pus. The onset of the disease is often announced by a chill. The febrile reaction is of a typhoid type, beginning with a slight elevation of temperature, which gradually rises, and after several days reaches its maximum intensity. The symptoms of the disease are, in addition to the chill and fever, evidences of pleurisy, pneumonia, or diarrhea. These symptoms will vary, depending upon the mucous membranes and the tissues most affected. The symptoms often resemble a septic intoxication like sapremia. Later, after the forming of foul ulcers, the symptoms may be those of septicemia and pyemia because of the rapid infection of the pus micro-organisms which are introduced into the ulcer. Usually death occurs within a week. In the acute form the mortality is from 85 to 90 per cent. In the chronic form it is much less severe and the patient may linger for

several weeks and even months. The disease runs a slow course and repeated abscesses form, which rupture, and the pus is discharged. Finally the patient may wear the disease out or the abscesses may have been opened and the pus discharged, the patient recovering after symptoms of chronic pyemia. Cases have been reported where twenty or more abscesses have been successively opened and the contents removed. The mortality in the chronic form is 50 per cent. In the acute form the pustules form over the face, hands, and arms and exposed parts of the body. The formation of the pustules in the skin is accompanied by edematous swelling so that the features are often horribly distorted. The history of the case and the eruption, together with the lymphatic enlargement and edematous swelling and evidences of pus forming, would be sufficient on which to base the diagnosis. The chronic form quite resembles syphilis, from which the diagnosis can be made by careful inquiry into the history of the case.

**Treatment.**—The treatment consists of (1) supportive, (2) surgical, and (3) antiseptic. The person should be given concentrated, highly nourishing, and digestible foods, and if necessary stimulants may be administered. Surgical treatment consists in opening the abscess as soon as it appears, removing the limiting membrane and the dead tissues. Rigid antisepsis should be maintained. All the abscesses, where they can be reached, should be drained and washed out with 1:20 solution of carbolic acid or 1:1000 mercuric chloride.

### Syphilis.

Syphilis is an infectious, contagious constitutional disease which runs a slow course and affects successively mucous membranes, lymphatic glands, skin, connective tissues, bone, eye, and nervous system. The cause of this disease is unknown, but it is believed to be due to a micro-organism. There are those who believe it to be caused by the absorption of inflammatory products, which seriously damage the general metabolic process. Others believe that the micro-organisms, or its products, are absorbed into the body and these circulating through the fluids bring about the changes characteristic of the affection. Lustgarten's bacillus was thought to have been the cause of the disease, but this has been proven not true, inasmuch as the germ is found in gummatous formations in the tertiary stage, whereas these are not infectious. It is a well known fact that the disease may linger for years within the system, finally breaking out and assuming many peculiar forms. It is hardly likely that the micro-organisms could have existed in the body during this long period. The symptoms of the disease have been explained by the absorption of the inflammatory products, the toxins of which disturb the metabolic process and bring about the production of granulatous tissue, which is prone to break down and ulcerate. Whatever is the cause of the disease, it seems to come in almost

all instances in a certain way and seems to run the same peculiar chronic or slow course. While the eruption may vary, yet it follows in sequence other symptoms, so that likely, as our bacteriological methods are improved, the cause of the disease will be determined. It is characterized by a period of incubation varying from two to four weeks, usually about twenty days, at which time a local sore appears, which is soon followed by lymphatic enlargement. This local sore is generally located on the genitalia, but may be found on the hands of the accoucheur, or upon the lips, tongue or nipple. Two to three months from the time of inoculation, or from forty to sixty days after the appearance of the primary sore, the skin and mucous membranes are affected. These are secondary manifestations or changes, the chief characteristics of which are that they are *generally symmetrical*. The second stage lasts from two months to two years, depending upon the treatment the case receives, and upon the habits of the patient and his surroundings. In some cases no further changes may be manifest. The disease seems to wear out, or after a few months or a few years, tertiary changes develop. They are usually asymmetrical and attack, besides the superficial tissues, the deeper structures, such as the connective tissues, bone, periosteum, muscles, viscera, liver, lungs, etc. The pathological formations in this stage consist chiefly of gummata. These gummata often lead to suppuration or to fibroid changes, perhaps to necrosis or to contractions of the tissues producing distortions or they may cause paralysis. Fibroid changes sometimes occur in the nervous system; these are manifest in various ways. The tertiary stage may last for life, the person dying of an intercurrent disease, whereas it may terminate fatally or the person may apparently get rid of the ailment after some years. Another peculiar fact about syphilis, which indicates that it is a specific disorder due to a micro-organism, is that it confers immunity to further attacks. *Chancre*, which is the primary sore of syphilis, may be multiple, where two points were infected simultaneously, but if a chancre has appeared at one point, having been thoroughly established, repeated efforts at inoculation at another point on the body have failed. Furthermore, after the chancre has healed and the patient is then the victim of secondary or tertiary syphilis, chancre will not again appear, nor can a person, under any circumstances, be inoculated. The disease is produced by direct contact with a chancre or the virus may linger upon a drinking cup or it may be introduced into the system by means of lymph in vaccination. The location of the chancre, as before mentioned, may be on the fingers, lips, tongue, tonsils, walls of the pharynx, or genitalia. In the female the chancre is usually located on the labia minora. It may be on the walls of the vagina or on the cervix uteri. In the male the chancre is usually found on the prepuce, but may be found upon the glans or situated in the skin back of the glans. It may be located in the meatus urinarius externus or back some little distance along the urethra. The appearances of a chancre are peculiar.

**Chancre—Primary Syphilis.**—Primary syphilis is the first stage in which there appears a chancre with enlargement of the lymphatic glands. The chancre must not be confounded with venereal ulcer or chancroid. Chancre exists in three forms:

1. Hunterian chancre is a hard, round, elevated, and inflamed mass which has ulcerated on the top. It does not suppurate and has a velvety edge or surface and bleeds easily. Hunter described the ulcerated surface as looking like raw ham. The discharge from the chancre is watery. This is not the most common form of chancre.

2. A hard, red, indurated mass which is situated beneath the epidermis, and from which the epidermis may, or may not, have been peeled off. This seems to be the most common form of chancre.

3. The rarer form is a purplish-red or purple patch situated in the skin, and which is exposed by removing the epidermis. This chancre is neither indurated nor ulcerated. Ulceration in a chancre seems to be brought about by irritation or friction or the presence of filth. A chancre is nearly always single. In most cases it has well defined margins which feel like encapsulated cartilagenous masses. These may be readily picked up between the fingers. The hard base is produced by inflammatory exudates. If the chancre is not properly treated it may exist for months, but the induration usually disappears after the secondary symptoms present themselves.

**Chancroid.**—A chancroid is a local sore which is very often multiple. It may be single in the beginning, but if allowed to remain for a few days will quickly become multiple. It appears in from one to ten days, never afterwards. The sore begins as a pustule, which ruptures, discharging a fluid which spreads over the surface and causes various other ulcers. The ulcer has thin undermined edges and is sharp-cut, and looks like it is punched out from the skin or mucous membrane. It looks sloughy and has a grayish base. The discharge is offensive. The tissues over which this pus flows will become inoculated. If the first sore was in the vestibule, other sores will be found along down the labia minora and labia majora, over which the discharge has run. It is a soft sore. They do not bleed or cause constitutional symptoms, but are followed (when situated on the genitalia) by inguinal adenitis or bubo. The lymphatic enlargement is on the side corresponding to the side of the genitalia affected. Should the chancroid be in the middle line, lymphatic enlargements may be manifest on both sides. This is unusual.

**Herpetic Ulceration.**—Herpetic ulceration may follow febrile reaction, but is usually due to an irritation set up by foul discharges or to filth. It first appears as a vesicle or group of vesicles, which rupture, discharging a clear fluid. These vesicles may run together, finally forming an ulcer. These ulcers are superficial, having no tendency to spread and are not indurated. They are, like chancroids, painful. Unless suppuration appears they are not attended by bubo.

**Mixed Sore.**—A mixed sore is a condition where the subject is infected with chancroidal poisoning and at the same time with syphilitic poisoning. In these cases the sore has the appearance and characteristics of a chancroid, but later along it comes to have a hard indurated base. These sores should always be regarded as “suspicious.” In no case should an absolute diagnosis be made by the appearance of the sore, but in all cases they should be treated alike—*cauterized*—and then treated as simple sores. Before the diagnosis of syphilis is made, the attending physician should await the development of secondary symptoms. Instituting treatment before secondary symptoms have developed will in no way benefit the case, for just as soon as the chancre appears, just so soon is syphilis a constitutional disease. Amputation of the chancre, followed by the proper healing of the wound, will in no way affect the course of the disease. Secondary symptoms will appear in due time. Chancre may be mistaken for cancer of the tongue. Chancre of the tongue is brownish red, whereas cancer is bright red. The discharge from the cancer is bloody, from the chancre it is non-purulent and free from blood. Cancer appears late in life. The lymphatic enlargements in cancer are painful, while those of chancre or syphilis are indolent. At all events, the diagnosis can be made in two or three months.

**Syphilitic Phagedena.**—This is a condition existing in persons surrounded by filth and debilitated by disease, in diabetics, drinkers, etc. Foul and spreading ulcers may happen coincident with the chancre or afterwards and these are best treated by methods advised for sloughing phagedena.

**Relapsing Chancre.**—After syphilis has been apparently cured for many years, the scar left by the chancre may become inflamed and enlarged, the chancre apparently returning.

**Bubo.**—A bubo is the enlargement from inflammation of the lymphatic glands above Poupart’s ligament. In syphilis it is generally bilateral and indolent. They may be small or large, usually freely movable underneath the skin and rarely ulcerate. In debilitated subjects the glands may enlarge enormously. In cases of mixed sore the buboes are very often suppurative. Where the chancre appears in the mouth the bubo appears below the jaw. They may remain for many months and finally disappear by absorption or fatty degeneration. After some months there may be general lymphatic involvement. This lymphatic enlargement affects *all* of the lymphatics, but those found in the posterior triangles of the neck and in the epitrochlear space back of the humerus are characteristic of syphilis. In syphilis the bubo consists of a chain of enlarged lymphatic glands, whereas in chancroid the bubo consists of an inflamed mass, seemingly produced by the inflamed glands fusing together. Syphilitic buboes grow slowly and are almost painless and are not red and inflamed. Chancroidal buboes are extremely painful, are red and inflamed and show a tendency to

suppurate. It is maintained by some that a positive diagnosis of syphilis can be made when an indurated sore is followed by bilateral buboes with involvement of other lymphatic glands. I should not advise the diagnosis to be made so early, but would wait until the development of the secondary symptoms.

**Secondary Syphilis.**—Secondary syphilis consists of certain changes in the skin and mucous membranes with general lymphatic involvement, and in some cases it is said to attack the iris. These secondary signs appear about forty days after the appearance of the primary sore or about two months after inoculation. They may be so slight as to be overlooked, or in some cases entirely absent. During the secondary syphilis the disease is very readily transmitted to the offspring through the ovum or spermatozoon, or by contact with the sores.

**Skin.**—The skin eruptions are various. It is peculiar that the eruption in syphilis may simulate the rash of almost any of the exanthemata. Frequently the onset of the rash is attended by a chill, high fever, and may be scarlatinous. In some cases it may be erythematous, in other cases it may resemble measles, while in still others it may be mistaken for small-pox. The eruption is usually a roseolous rash spreading over the back, chest, and abdomen. It is generally accompanied by a sore throat. The rash seems to be caused by a local congestion, since it fades under pressure. It usually disappears in a short time, but if the rash continues, inflammation of the skin will occur at the points of the rash. Sometimes the epithelium will form scales; these are called *scaly syphilides*, the eruption taking on the appearance of psoriasis. It may manifest itself in a distinctly papular rash, which is called a *papular syphilide*. In other cases, where it is still more severe, little vesicles may form on top of the papules, *vesicular syphilides*. In a certain class of vesicular syphilides, where the process seems to be more severe and there is marked exudation of serum, large bullae are formed; these are called *bullous syphilides* or *syphilitic pemphigus*. In some cases the contents of the vesicles are converted into pus, *pustular syphilides*, or *syphilitic ecthyma*, a condition where the pustules form scabs, which afterwards dry up and fall off, leaving no scar. *Syphilitic rupia* is a condition where marked ulceration takes place underneath the scabs.

**Mucous Membrane.**—Following the eruptions, ulcers appear upon the mucous membrane of the mouth and throat. They are called mucous patches. The first ulcers are usually symmetrical. They are usually painless and often temporary and superficial. Sometimes the mucous patch presents an appearance of condyloma. Mucous patches may also appear upon the mucous membranes of the genitalia and rectum. Mucous patches are prominent in smokers or people with badly neglected teeth. These patches sometimes affect the larynx, causing hoarseness and even loss of voice. The nasal mucous membranes may be affected so as to produce a discharge and evidence of

catarrh. It is not unusual that mucous patches may occur in the urethra, causing an infectious discharge. It is during this stage that the disease is communicated as the sores are very infectious.

**Hair.**—The hair falls out, sometimes rapidly and extensively. It may be so widespread as to affect the beard and eye-brows, or it may be limited to the production of bald spots on the scalp. This baldness, which is known as *alopecia*, begins about the time of the appearance of the eruption. The baldness is not permanent, as the hair will again appear. The bald places are not as smooth as in other forms of alopecia and the skin is scaly.

**Nails.**—The nails may be entirely or partially cast off, due to inflammation of the matrix. The new nail formed is often diseased.

**Eyes.**—Iritis is the commonest eye trouble in secondary syphilis. It appears about four months after the chancre; in fact, acute iritis developing is said to be a strong symptom of syphilis. It is shown by a pink zone around the sclera and a muddy, reddish iris. The pupil is irregular and there is intense photophobia and pain. The pupil may be hazy. The patient usually recovers from the syphilitic iritis with good vision. The retina may become affected by diffuse retinitis or there may be a choroiditis. The diagnosis of these affections can be made by means of the ophthalmoscope.

**Ear.**—Rarely temporary impairment of hearing takes place, generally symmetrical. Sometimes it may lead to deafness.

**Bones and Joints.**—Rarely there may be a periostitis set up, but this is usually a manifestation of tertiary syphilis. Likewise the synovial sacs may be affected, causing more or less synovitis, but these inflammations are more or less transitory and not very painful. No destructive disease either of the bones or joints occurs. Intense headache may appear because of periostitis of the bones of the skull.

**Testicle.**—Sometimes the epididymis and testis may become inflamed. This is sometimes followed by atrophic cirrhosis, while in others the plastic exudate is absorbed without injury to the organs.

**Tertiary Syphilis.**—Tertiary syphilis appears after a latent period which follows the secondary syphilis. This latent period varies in length; in fact, the secondary syphilis may exist for from four or five to eighteen months. Tertiary syphilis will appear within six months or two years. There are some cases in which the tertiary symptoms are manifest after a few months, in other cases they are greatly delayed. The tertiary symptoms are announced by chronic inflammation of the various organs and tissues leading to the formation of gummata. These gummata may vary from the size of a pea to that of a walnut and are very intimately blended with the surrounding tissues. These gummatus formations may undergo caseation and break down, producing, when in the submucous tissues, a characteristic ulcer or they may continue for some length of time, disappearing under favorable treatment, or in other cases may leave a hard fibrous mass, contractions

of which seriously interfere with function and produce great deformity. These gummata are formed of granulation tissue and are made up, for the most part, of three zones, a central zone, indicating degeneration, principally fatty. This is surrounded by a matrix made up of cells undergoing fibrillar changes. The outer zone contains numerous ramifying vessels between which are the granulation tissue cells.

**Tertiary Lesions.**—The tertiary lesions are (1) gummatous inflammations of the periosteum and of the bones leading to caries or necrosis occasioning deformity. When the nasal bones are affected the ulcerative and necrotic process may destroy the entire nose, the nasal septum and pterygoid bones, producing horrible deformity.

(2) Gummatous inflammations in the skin and mucous membranes (tubercular syphilides). This is a condition in which tubercles are formed. These sometimes break down and form *serpiginous* ulcers. These are symmetrical, involve the deeper tissues and show no tendency to heal. When the larynx, pharynx, and rectum are affected, serious damage may result by the formation of strictures and gummata.

(3) Gummata may form in the muscles, producing paralysis and injury to the muscles affected. Where this occurs in the tongue, serious damage from ulceration and cicatrization may take place.

(4) Gummata of the nervous system produce paralysis and when they involve the anterior or frontal lobes of the brain they produce marked psychological symptoms. It may lead to fibroid changes in columns of the cord, medulla, or in the cerebellum.

(5) Gummata of the blood vessels. The arteries are chiefly affected and this results in the formation of thrombi, emboli, and aneurysm and rupture of the arteries.

(6) Lastly, gummata may form in the viscera, liver, lung, or kidney, producing symptoms according to the nature of the organ and the extent of involvement.

Hutchinson enumerates the lesions of tertiary syphilis in this manner: Diseases of the skin of the nature of rupia or lupus, periostitis of bone forming nodes, causing hypertrophy, caries or necrosis; gummata in various parts, as of the tongue, causing sclerosis, of the nervous system introducing structural changes, causing ataxia, ophthalmoplegia, internal and external; general paresis, paralysis of cerebral nerves, optic atrophy, myeloid degenerations; and chronic inflammations of certain mucous membranes, such as the mouth, pharynx, vagina, and rectum, with ulceration, thickenings, and strictures. It may affect the spine in the form of spondylitis, at the same time involving the meninges of the cord. Unilateral enlargements of the testicle and epididymis may take place. Serpiginous ulcers in tertiary syphilis are preceded by brown or copper colored spots. These spots break down often, forming crescentic shaped ulcers. They are more common about the lips and nostrils and on the face. Involvement of the periosteum and connective tissues will lead to severe pains, *syphilitic rheumatism*, so that

pressure on the front of the tibia will usually occasion considerable pain. These rheumatic pains are greater when a person becomes warm after retiring at night. They often involve the ribs, showing tenderness throughout the extent of one or more.

Syphilis of the nervous system comes on late and is indicated by meningitis, atheromatous condition of the vessels, fibrosis, and gummatous formation. Syphilitic paralysis is progressive, limited and not complete. Epilepsy appearing after the thirtieth year, not due to alcoholism, is likely due to latent syphilis. A syphilitic patient often has persistent headaches, insomnia, muscular tremor, paralysis, slowness of utterance, and vertigo. Spinal syphilis is manifested in the form of sclerosis as in Landry's paralysis. There may be a condition of softening and tumor. Syphilis sets up a neuritis of a chronic form, accompanied by degenerations as in locomotor ataxia.

**Congenital Syphilis.**—Congenital syphilis occurs in children only when both of the parents are syphilitic. It is transmitted to the child by means of the ovum or spermatozoon. The child is born healthy, while the disease usually appears from the fourth to the sixth week after birth. There are cases where it is said the child was born with evidence of syphilis. There are other cases where the development of the disease seems to be considerably delayed. The symptoms of the affection in general are those of "snuffles" or a chronic catarrh. Mucous tubercles and ulcerations are present about the mouth and anus. The discharge from the nose is generally copious and non-purulent. A rash appears on the body similar to that in secondary syphilis of the acquired form, later copper colored spots appear about the genitalia and buttocks and on the hands and feet. These may be followed by ulcerations. Eruptions may be papular, vesicular, or pustular. Generally the child is anemic and wasted. It has a shriveled and shrunken appearance and looks old, so that a child of a few months has the face of an old man. The hair falls out and eyes become affected, ulcers and keratitis producing an opaque condition of the cornea. Deafness usually follows while the bones and joints and viscera are all affected. Where the symptoms appear late or where the child seems to survive the secondary symptoms, changes in the bones occur, producing a broad bridge of the nose. Ulcerations take place at the angles of the mouth. These on healing leave scars (Hutchinson's lesion). Usually there is a peculiar conformation of the skull. The head is square with prominent frontal eminence. The incisor teeth are characteristic; the edges are serrated and concave, and sometimes they look as if they were cut out. Enlargements on the bones sometimes occur. These are called Parrot's nodes.

FIG. 6.



Hutchinson teeth in hereditary syphilis.

Rules governing the inheritance of syphilis may be summed up in the following:

1. **Colles's Law.**—Children having inherited syphilis from the father, the mother never having manifested the disease, the mother is immune to syphilis so that she will not contract it from the nursing child. A wet nurse would.

2. If one parent is syphilitic the child may be.

3. Syphilitic parents may bring forth healthy children.

4. If the mother, while enceinte, contracts pox, the child may have syphilis. Under such circumstances it becomes infected in utero.

5. The more recent the syphilis the more likely it is the child will be infected, and the more latent the syphilis the more tardy and less likely will be the development of the syphilis in the child.

6. Syphilitic parents may beget several syphilitic children when afterward they may bring forth healthy children.

7. Syphilis not having manifested itself for a number of years, the child may not have syphilis.

8. Syphilis in the mother is much more dangerous to the child. She often aborts at the fifth month.

#### Treatment.

A. Osteopathic. B. Other measures.

**Osteopathic.**—The treatment has not as yet been tested in full to determine its effects in all forms of this disease. We hold it to be a nutritive disorder due to the absorption of inflammatory products. In the lesions of tertiary syphilis osteopathy has been peculiarly successful. Especially is this true of gummata, paralysis, rheumatism, eye affections, and ulcerations. In all these conditions we depend upon increasing the blood supply to the diseased part. This enables the young granulation tissue cells to mature. It further hastens the resorption of the inflammatory, degenerated, and other products present in the disease. This treatment if properly applied ought to relieve the various forms of tertiary syphilis readily and completely. The treatment is the surest and most powerful method of reconstructing and renovating the tissues. The poison is eliminated by the excretories while the recuperative powers are replenished by securing a good free flow of fresh and wholesome blood.

**Other Treatment.—Chancre.**—As soon as seen a chancre must be cauterized with fuming nitric acid or carbolic acid. Afterwards it should be treated as a simple sore—dusted with calomel, and borated gauze and cotton applied and held in place by a bandage. When on a mucous surface an antiseptic solution may be used twice daily.

**Bubo.**—The treatment as advised in inflammation will be found applicable here. They rarely cause trouble. It will do no good to rub in salves or apply liniments. If the treatments are persisted in the inflammatory products may be absorbed.

There are three methods now in use which affect very favorably the course of syphilis. They are the following: 1. The inunction treatment consists of rubbing into the skin on different parts of the body fifteen to thirty grains of mercurial ointment daily. Rubber gloves are necessary. The treatment is extensively used.

2. Daily hypodermic injections of one-fourth grain of the bichloride of mercury over the back and buttock for one month is a treatment said to be very successful. If the disease reappears one-sixth grain of the drug may be similarly injected for a period of one month. If it again reappears one-eighth of a grain may be injected in the same manner.

3. Iodid of potassium in a saturated solution is extensively used in the treatment of old syphilitic lesions. It is begun with ten drops three times daily in a glass of water and increased one drop at each dose until two hundred drops are taken three times daily.

**Diet and Hygiene.**—In syphilis it is of the utmost importance that the patient eat plain, wholesome, and non-stimulating food. He should take frequent baths, drink copiously of pure water, avoid stimulants of all kinds such as tea, coffee, tobacco, and alcoholics. Good clothing should be worn and the victim should receive a good night's sleep. All the secretions should be kept active and regular.

### Gonorrhoea.

Gonorrhoea is a specific ulcerative inflammation of the urethra in the male, and the vagina in the female. This inflammation frequently extends into other organs, sometimes even affecting the eye, it having been inoculated by pus transported to it from infected hands or cloths. There are two forms of urethritis usually described in the male, the specific and non-specific.

The non-specific form of urethritis is produced by irritating discharges, by injury or by micro-organisms. The symptoms are usually mild, the inflammatory reaction is not severe and it generally runs a short course. The sequels are of no consequence.

The specific form of urethritis is produced by infecting the mucous membrane with the diplococcus Neiseri. This micro-organism finds its way into the deeper layers of the epithelial cells and into the connective tissues, setting up an ulcerative process. There may be several ulcers along the urethra. These may extend partially or entirely around the canal, usually only upon one side. The inflammation is quite severe, the inflammatory products being carried through the lymphatic channels into the glands in the groin set up an inguinal adenitis producing bubo. In severe forms the dorsal veins may become involved, phlebitis occurring so that they appear as hard, fibrous, and painful cords. The corpus spongiosum becomes infiltrated with inflammatory material and is not capable of distention and stretching, as normally, when upon erection of the corpora cavernosa it occasions a condition of

chordee or bowing of the organ. The gonococci are found in large numbers in the pus discharged from the urethra. The germs inhabit the pus cells, epithelial cells, and the albuminous fluids. They can be readily stained with the ordinary anilin stains (dilute methyl blue or methyl violet). It is claimed that there is a certain proportion of cases where no gonococci can be found, in which the symptoms are quite as severe as in specific urethritis. The cause in these cases seems to be pus micro-organisms.

**Symptoms.**—Gonorrhœal urethritis may be divided into three stages. The first stage is from the time of inoculation until inflammation is set up. The second stage is the acute inflammatory stage, which lasts about ten days. The third stage is the defervescence of the inflammation, and lasts two or three weeks, sometimes less.

The first symptom of gonorrhœa is an irritation within the meatus urinarius externus. The meatus becomes swollen, congested, and a watery fluid exudes. There is pain on urination and during the intervals a teasing sensation. The discharge becomes purulent within a few days. The disease, after inoculation, generally appears in from one to four or five days. The purulent discharge, as soon as the ulceration is set up, becomes quite copious and is sometimes greenish, due to the association of some of the pus germs. The organ becomes badly swollen, urination causes excruciating pain, while there is a continual ache extending along the back of the organ and about the rectum, sometimes being referred over the trochanters. After the acute stage is over the inflammation gradually subsides, the discharge becomes less free and thinner—seropurulent and finally serous, and eventually disappears. Cicatricial contractions take place in the ulcer formed within the urethra. This contraction may narrow the caliber of the urethra, producing stricture. In chronic cases the ulcer never quite heals, but cicatricial contraction takes place and because of the obstruction by the stricture the urethra behind the narrowed point becomes distended by the urinary flow. It is from this distended portion that the discharge in gleet or chronic urethritis comes.

**Complications.**—The complications of gonorrhœa are:

1. Balanitis, and inflammation of the glans penis.
2. Posthitis, a condition where the prepuce becomes inflamed. In balanitis if the prepuce is redundant and becomes inflamed while behind the glans a condition of paraphimosis may result. If posthitis is set up a condition of phimosis may be caused, in which condition the prepuce cannot be brought back over the glans. (See Phimosis and Paraphimosis.)
3. Chordee is a condition of bowing of the organ and happens in many cases. The treatment consists of the application of cold or other means of preventing erection. The patient should be instructed to sleep on his side and with but little cover.
4. Stricture of either large or small caliber is a frequent result of

gonorrhoeal inflammations because of cicatricial tissue formed in the urethral wall, the contractions lessening the lumen of the urethra.

5. Prostatitis. In some cases the inflammation extends back the urethra into the prostate gland. Prostatitis can be recognized because of the swollen and inflamed condition of the prostate, and because of the febrile reaction due to the absorption of pus.

6. Epididymitis. The inflammation may travel back along through the vesiculæ seminales and the vas deferens into the epididymis, causing epididymitis, or even the testicle itself may become inflamed, orchitis.

6. Gonorrhoeal Rheumatism. This is caused by the absorption of the inflammatory products of gonorrhoea, which are carried about over the system and lodge in the connective tissues about joints, causing inflammation. It is not a rheumatic condition.

**Treatment.**—The Osteopathic treatment consists in increasing the urinary flow and lessening its acidity as recommended by Dr. A. T. Still. This will lessen the irritation during urination and quiet the desire for frequent micturition. The blood supply to the urethra must be stimulated and the penis carried in a sack containing cotton to catch the discharges. The acute inflammation will subside in a week or ten days. The bowels must be kept regular and the patient instructed to avoid undue exercise or excitement. He should get good sleep, avoid the use of stimulants and eat good plain food. *By all means avoid injections.* They do harm. Never good. In *chronic* gonorrhoea or gleet a 4 per cent. solution of nitrate of silver may be injected gently into the urethra and held there just two minutes. If this does not effect a cure, every other day a 2 per cent. solution of the silver salt may be injected—care should be taken not to force the fluid into the bladder. The irrigation treatment is very popular. It consists of daily running through the diseased part of the urethra, or even into the bladder, a 1:4000 solution of permanganate of potassium. Two or three quarts should be allowed to pass through the urethra at a sitting. The treatment is said to be very successful. In the female the treatment is similar. When the disease is chronic the vagina may be tamponed daily with a boroglyceride tampon and irrigated with a solution of a teaspoonful of acetate of zinc to a pint or quart of distilled water.

#### Rachitis, or Rickets,

Is a disease of childhood. It occurs in children from eighteen months to two and a half years of age. It affects the entire system more or less, but especially the long bones and the bones of the skull. The cause of rickets is malnutrition. This malnutrition may be the result of lesions causing malassimilation or because of an insufficient quantity or quality of food. It may be caused by the debility of the mother or by the child being surrounded by bad hygienic conditions. It is characterized by the formation of embryonic tissues. These embryonic tissues never develop into the mature cell for which they were originally intended. Bones

are not properly formed, the cells proliferate, but the ossific process does not take place.

**Symptoms.**—The symptoms of the disease are, first, its occurrence in children eighteen months to two and a half years—or in the late form it may happen in children from nine to twelve. This is said to be a recrudescence of the disease. The child is at first restless and may have night sweats. Phosphates are abundant in the urine, and there are evidences of gastro-intestinal disturbance and flatulence. Swellings occur on the ends of bones, radius and tibia, beading of the ribs and thickening of the cranial bones at the sutures. The bones frequently bend, causing bowing of the legs. There may be bowing of the forearms. There may be many deformities, the most common being pigeon-breast. The person is often knock-kneed or bow-legged and there is curvature of the spine. There are various kinds of deformed pelvis. The fontanel's close late and the head is square. Dentition is delayed or may not occur at all and even if the teeth appear they may decay early and fall out. Ofttimes there are symptoms of bronchitis. There may be laryngismus stridulus, convulsions, diarrhea, etc.

**Treatment.**—The treatment of rickets is to locate the cause of the disease, if there is any. Generally there are Osteopathic lesions which account for the malnutrition. The reduction of the lesion, together with the proper food, will be attended by relief.

### Scurvy.

Scurvy is a disease of malnutrition and malassimilation from improper food. The cause of the disease is lack of vegetables. It has occurred in prolonged sieges or Arctic expeditions. Scurvy was common among those who visited the Klondike. The pathology of the affection is the pathology of a condition of malnutrition. Improper food materials lead to disorganization of the blood and there is degeneration of muscles and great prostration. The skin becomes jaundiced (hematogenous). There is malaise, torpor, loss of appetite, and insomnia. The gums become inflamed, of a bluish-purple hue, are friable and break down and ulcerate. The breath becomes fetid, the skin dry and brittle and because of the changed condition of the blood there are ecchymoses underneath the skin and around through the muscles, even under the periosteum. The *prognosis* is generally good unless the case is in a very bad condition before the proper treatment can be administered. In prolonged and neglected cases death results from marasmus and sepsis. The *treatment* is a vegetable diet in small quantities, frequently repeated, fresh fruits, cranberries, lime juice, buttermilk and cider.

### TUMORS.

**Definition.**—A tumor is an atypical neoplasm or new formation which is not the result of inflammation. The word "tumor" means a swelling.

but all swellings are not tumors. The term tumor is applied to those new formations which arise from other than inflammatory causes, although the tumor may be attended by an inflammatory reaction, and, furthermore, a long continued irritation and inflammation may even operate as one of the causes of a tumor.

**Cause.**—"All have agreed long since that tumors and issues mark a cut-off in an artery, vein, or nerve." (A. T. Still, *Philosophy of Osteopathy*, page 200.) Lesions acting in this manner occasion nutritional disturbances. These disturbances vary in nature and degree, causing abnormal development or destruction of cells from perverted nutrition or retained secretions. Among the various other causes which seem to have to do with the origin and development of tumors may be mentioned:

1. **Constitutional Dyscrasia.** By this is meant a certain morbid condition of the system which predisposes to the development of tumors.

2. **External Irritation.** External irritation seems in some instances to assist in the formation of tumor. It is not unusual that a cancer arises from a crack in the lip which has existed for several months or years.

3. **Embryonic Remains.** During development of the fetus embryonic tissue may be included in parts of the body where it should not be and afterwards in growing or developing forms a tumor. This without doubt explains teratomata, but does not explain sarcomata and many other tumors.

4. **Parasites.** Cancers can be readily transmitted. Because of this some writers maintain that a cancer is due to a parasite. This remains to be proven. Numerous forms of certain parasites have been described but they are most likely optical illusions.

5. **Spermatic Influence on Cells.** It is maintained by some pathologists that certain cells have a spermatic influence over others, changing their method of development and producing abnormal growth.

6. **Defective Tissue Resistance.** This has been advocated in explaining cancer. Cancer consists of a condition where the epithelial cells, instead of growing towards the surface, grow down amongst the deeper tissues and in the lymph spaces. Because of a lessened resistance which the connective tissues seem to have for the epithelial tissues, they grow the wrong way. This would not explain some of the tumors.

7. **Certain Predisposing Causes.** It is said that in some people there is a predisposition to the development of cancer. Not that they have a dyscrasia, but that they have inherited the condition from a cancerous mother or father. This remains to be proven.

**Structure.**—The structure of a tumor varies according to its location and the issues from which it arises. The tissues of a tumor always resemble the tissues from which they grow and develop. Metaplasia of tissue never occurs. By that we mean that from connective tissues epithelial cells never develop. If a tumor is derived from the connective tissues,

it will always be a mesoblastic tumor, not hypoblastic or epiblastic. Wherever a cancer is found it is always developed from epithelial tissue. Wherever a sarcoma is found it is developed from mesoblastic tissues, so that in structure the tumors resemble certain tissue types. Some tumors differ but very little from the normal tissues, while in others the cells vary in shape and become so distorted as to render it difficult to determine their nature. These are atypical. The most atypical of all tumors and tumor-cells is the cancer. A tumor is independent of the general nutrition of the body. While the body is becoming poor, thin and emaciated, a fatty tumor may grow to immense proportions. While the more emaciated and debilitated the patient becomes, the more luxuriantly does the cancer grow. Many of the tumors do not have a distinct blood supply. Many of them grow at the expense of the body.

**Shape.**—The shape of a tumor may be ragged or irregular, it may be circumscribed and enclosed within a capsule, or it may be difficult to tell where the tumor begins and the healthy tissues cease. In such conditions the tumor seems to infiltrate the surrounding tissues. The tumor may have a fungiform appearance or it may be papillary, or in some cases it may present a cauliflower excrescence, as in case of a cancer of the mucous surface.

**Effects on the General Health.**—The effect of a tumor on the general health varies according to the nature of the tumor and the tissues involved. The mechanical pressure of the tumor may be such as to markedly interfere with the general health. This is not the rule. Tumors may grow to enormous size and yet the person may be apparently healthy. Still, on the other hand, a little cancer not larger than a hickory nut may cause profound cachexia and a condition of malnutrition. The effects on the general health are produced by mechanical irritation and pressure upon an artery, vein, or nerve, which sometimes may be serious to a part, or by a certain form of poisoning whereby noxious chemical products are discharged into the body from the tumor. These carried about produce general systemic effects. Something like this occurring makes a cancer a constitutional affection. The general health is likewise impaired in malignant tumors by the using up of a great amount of nutritious material, thereby depriving the tissues generally of their nourishment.

#### Classification.

##### Clinical.—

- A. Benign.
- B. Malignant.

##### Tissue Types.—

- A. Mesoblastic.
  - I. Simple tissues.
    - 1. Fibroma.
    - 2. Myxoma.
    - 3. Lipoma.

- 4. Osteoma.
- 5. Papilloma.
- 6. Chondroma.

## II. Complex tissues.

- |                  |             |
|------------------|-------------|
| 1. Myoma.        | 5. Neuroma. |
| 2. Angioma.      | 6. Glioma.  |
| 3. Lymphoma.     | 7. Adenoma. |
| 4. Lymphangioma. |             |

## III. Embryonic tissues.

- |                          |                      |
|--------------------------|----------------------|
| 1. Sarcoma.              |                      |
| a. Large round-celled.   | e. Giant-celled.     |
| b. Small round-celled.   | f. Mixed-celled.     |
| c. Large spindle-celled. | g. Alveolar sarcoma. |
| d. Small spindle-celled. | h. Melano-sarcoma.   |

## B. Epiblastic and Hypoblastic.

## I. Carcinoma, or Cancer.

1. Epithelioma, or squamous-celled carcinoma.
2. Glandular cancer, or cylindrical-celled carcinoma.
3. Acinous cancer, or spherical-celled carcinoma.

A **Benign** tumor is one which does not affect the general health, but the symptoms of which are entirely due to the mechanical pressure or irritation which the tumor may exert upon the surrounding structures.

A **Malignant** tumor is one which affects the body out of proportion to its size. It affects the general health. It usually runs a rapid course and results fatally. It is attended by cachexia, great pain, ulceration, etc.

A **Fibroma** is a tumor made up of bundles of wavy fibrous connective tissues. The varieties seen are (1) hard fibroma, (2) soft fibroma, (3) molluscum fibrosum, and (4) keloid. In addition to these varieties there may be intermingled with the fibrous structure of the tissue, fatty or myxomatous tissues, bone, cartilage, etc., or in other cases a degenerated condition of the vessels, making the following additional varieties: (5) Myxo-fibroma, (6) Fibro-lipomatodes, (7) Osteo-fibroma, (8) chondro-fibroma, and (9) angio-fibroma.

**Changes In.**—The changes which these tissues very often undergo are calcification, ulceration, and mucoid degeneration.

**Location.**—The tumors are located in the connective tissues, beneath the mucous and serous membranes. Where they occur in the periosteum they produce a condition of fibrous epulis. Where they occur in the uterus a condition of myo-fibroma results. A tumor may form in the stumps of nerves after amputation. This is improperly called a neuroma, it is really a fibrous tumor or false neuroma. When fibrous tumors occur in the nose and rectum they are generally in the form of polypi. In subcutaneous tissues hard and soft fibromata occur. Soft fibromata are popularly called "wens." These tumors are never malignant.

**Diagnosis.**—The diagnosis is usually easy. The tumor is encapsulated, often lobulated, generally pedunculated, and is a hard fibrous mass. It is a benign tumor, may appear at any age and if removed will not tend to recur.

**Molluscum Fibrosum.**—This consists of an overgrowth of the fibrous structure of the skin and subcutaneous tissues. It may affect one side of the head or one entire side of the body. The skin may become enormously thickened. It is said the origin of the tumor is congenital.

**Keloid.**—This is a rare kind of tumor which occurs in two forms, spontaneous and cicatricial. The spontaneous consists of a fibrous mass beneath the epidermis and is more common in the negro.

The cicatricial form arises from scars, frequently from piercing of the ear. The tumor is benign, but is prone to recur unless every vestige is removed.

A **Myxoma** is a tumor consisting of mucoid tissues. The tissues of the tumor are not matured, but are an undeveloped form of connective tissue. The contents of the tumor are identical with the tissues surrounding the blood vessels in the umbilical cord. It is made up of stroma, having within the tissue-spaces a substance similar to Wharton's jelly. The tumor appears to the naked eye as being made up of a structureless gelatinous mass. It is a soft, gelatinous, grayish, or reddish-white tumor. It comes after middle life and grows slowly. They do not recur after removal. They are benign tumors. They may undergo fatty degeneration, inflammation, ulceration, or may form cysts.

**Location.**—They are located in the submucous, subcutaneous, and subserous tissues.

**Treatment.**—When easily accessible they should be removed.

A **Lipoma** is a tumor made up of fatty tissue. Its structure is that of ordinary adipose tissue. It is usually lobulated, soft, and pseudo-fluctuating. They are ovoid, spherical, and rarely pedunculated. The tumor is encapsulated and sometimes becomes slightly attached to the surrounding tissues so that gravitation may cause these tumors to migrate, say from the side of the chest to the brim of the pelvis.

**Degeneration.**—Degenerative changes taking place in these tumors are ulceration, calcification, and softening. Ulceration is sometimes serious. Calcification may lead to error in diagnosis.

**Location.**—The location of these tumors is generally the axilla, back, buttock, and thigh.

**Diagnosis.**—These tumors are benign, of slow growth, and variable in size. They appear at any age, are encapsulated, and if the tumor is grasped at its base and the skin stretched, dimpling of the surface will take place because of the fibrous bands extending down through the tumor.

An **Osteoma** is a tumor formation developed in bone after inflammation. It generally occurs at the junction of the bone and its cartilage. There are three forms usually described, depending upon their structure. (1) Eburnated osteoma consists of very dense bony structure, made up of lamellae extending parallel with the surface of the tumor. They are symmetrical and often multiple. (2) Compact osteoma is a

variety consisting of compact bone. It is found in the outer layers of long bones. (3) Cancellous, or spongy osteoma is a tumor made up of cancellous bone. In structure it resembles the spongy bone at the end of long bones. The tumor may become sarcomatous or it may undergo necrosis following inflammation. Rarely caries takes place.

**Diagnosis.**—It is a benign tumor of slow growth. It is generally arrested as age advances and never attains a very large size. If it exhibits malignant characteristics it is a sarcoma.

**Papilloma.**—The common name of this tumor is a wart and consists of a fibrous stroma containing blood vessels and lymphatics. It seems to be an overgrown or hypertrophied papilla of the skin. In some cases the papilla may be short or in other cases long, where it presents a villus-like appearance. Where the wart is situated in the skin the epithelial covering is sometimes dense and binds the wart in a solid mass.

**Changes In.**—Ulceration and hemorrhage; it may become cancerous.

**Location.**—Skin and mucous membranes.

**Diagnosis.**—The diagnosis is easy. They occur at any age, may be simple or multiple. They may disappear without operative interference. When they occur on mucous surfaces they are highly vascular, prone to bleed, and may occasion considerable trouble. Where they are at a point of irritation they should be removed.

**Chondroma**, sometimes called enchondroma, is a mass of new tissue composed of hyaline, white fibrous, or elastic cartilage. They are usually rounded, smooth, lobulated tumors of dense consistency. They sometimes have a well marked capsule. The cut surface presents a pink appearance identical with fresh cartilage. They are non-vascular.

**Location.**—Cartilages of the larynx, trachea, and costal cartilages.

**Changes In.**—They may undergo fatty, mucoid, or calcareous changes and are often found in bone developed from cartilage. They are not uncommon in the metatarsal bones and phalanges, and may occur in glands such as the testicle, ovaries, and mammae.

A **Myoma** is a tumor composed of muscle. There are two forms usually recognized, depending upon the kind of muscular tissue. That composed of striated muscle is called Rhabdomyoma. That composed of unstriated muscle is called Leiomyoma. *Rhabdomyoma* is very rare and it is maintained by some to never occur. It is usually congenital. The muscle fibres are irregularly formed, either spindle or club shaped. It is a benign tumor and occurs in the heart, uterus, and kidney. *Leiomyoma*, the variety made of unstriated muscle, frequently contains more fibrous than muscular tissue. It is most frequently located in the uterus, but may occur in the prostate, esophagus, stomach, and intestines. As a rule, they vary greatly in size; those located in the intestines are small, while those located in the uterine wall may attain an enormous size. Severanu removed one which

weighed 195 pounds. They are frequently the size of a fetal head. When located in the uterus they may be subserous, interstitial, or intramural. They may be pedunculated in the form of uterine polypi. They are generally encapsulated and made up of elongated, spindle-shaped cells with rod-shaped nuclei and have but few blood vessels. The tumors may undergo inflammatory changes or calcareous degeneration. They are benign, but may become sarcomatous.

An **Angioma** is a tumor made up of blood-vessels. There are three different forms, capillary, venous, and arterial, or, *simple*, *cavernous* and *plexiform*.

*Simple or capillary angioma* is a condition of telangiectasis, or mother's mark, or birth mark. It generally affects the skin and may be flat or slightly elevated and may vary in color from a pink or red to a dark-red or violet. They are generally located on the face, about the orbit, and on the neck, and are congenital. They may increase in size after birth. On microscopical section it is found that the walls of the capillaries and vessels are thin, dilated, and fusiform. They may be cylindrical or sacculated, or several large vessels may establish communication between the nevus, as it is sometimes called, and the main artery.

**Location.**—They are generally located in the skin and subcutaneous tissues in any of the organs which are vascular.

**Arterial angioma**, sometimes called cirroid aneurysm, is really not a tumor, but a pathological alteration of the vessel wall. The vessels become distended and convoluted. Pressure upon the nerves and tissues causes atrophy. The vessel walls usually thicken because of inflammatory reaction. The tumor may be congenital or acquired. Both the venous and arterial angiomata may follow injury of the scalp, frontal region, and the pudendum.

**Lymphoma.**—The term "lymphoma" means a tumor of the lymphatic gland. There are various conditions which may perhaps be included under this head. Enlargement of the lymphatic glands in tubercle and syphilis is termed by some tubercular or syphilitic lymphoma. There is no inflammatory reaction due to the absorption of the products of inflammation, as in bubo or acute and infectious diseases. Sarcoma may occur in the lymphatic glands, but it does not differ from a sarcoma in any other region, except that it arises in the lymphoid tissue. This tumor is called lymphosarcoma. The lymphatic enlargement in leukemia is said by some to be malignant. Enlargement of the lymphatic glands with enormous hypertrophy, as occurs in Hodgkin's disease, is called lymphadenoma.

**Lymphangioma** is a tumor of the lymphatic vessels. It is very rare and consists of dilated and cavernous sacs. It is analogous to a tumor of the blood-vessels. It occurs most frequently in the tongue or lips, where it is termed macroglossia or macrocheilia, as the case may be.

A **Neuroma** is a tumor of the nervous tissue. The existence of these tumors is denied by some writers. An amputation neuroma is really a fibrous tumor due to the development of fibrous tissue in the stump of an amputated nerve. Pathologically there are other neuromata described in connection with ganglia and masses of nerve matter, but they are rare and not well understood.

A **Glioma** is a tumor developed from neuroglia and composed chiefly of glia cells. The tissue elements vary greatly. These tumors are often located in the eye. Some writers believe that they are true sarcomata. In the brain the glioma does not involve the membranes, while a sarcoma does. They are circumscribed, diffuse slowly, and generally affect the central nervous system (brain and spinal cord). The tumor may be very soft or firm and elastic and is single. When metastasis occurs it is believed to be sarcomatous.

An **Adenoma** is a tumor of the type of glandular tissue. It seems to be an enlargement of all parts of the gland. It is believed by some that the origin of the tumor is fragments of glandular tissue included within the tissues where it is found. Sometimes they are termed localized hypertrophies. They are benign, and secondary changes are not liable to occur, but when they do, they are fatty or mucoid in nature. Where gland tubules are developed, cysts may be formed because of the retention of the secretion.

**Location.**—Sebaceous glands, mammary glands, thyroid, prostate, testicle, liver, spleen, etc.

There are two forms described, depending upon the nature of the formation or structure. They are tubular and acinous.

A **Sarcoma** is an embryonic connective tissue tumor. The cellular elements of the tumor predominate over the interstitial substance. The cell elements tend to infiltrate the surrounding tissues, so that it is not always encapsulated.

**Microscopical Structure.**—The microscopical structure of a sarcoma is of great importance. It consists of embryonic cells, varying in size and shape, embedded in a stroma or intercellular substance, which varies in amount and character. It generally contains but little fibrous tissue. The cells are often protoplasmic masses and rarely possess a cell wall. The variety of the tumor depends upon the shape and size of the cells. The intercellular substance extends around between all the cells and lies in close connection with the individual cell. The blood-vessels of the tumor are very numerous and often have no well defined walls, the blood apparently flowing into cavernous spaces in the tumor, so that the blood is apparently brought in direct contact with the tumor cells. Sometimes these embryonic cells which form the vessel wall become detached and are carried by the blood current to other parts of the body (metastasis). When the tumor grows slowly there apparently is a condensation of the connective tissues about the tumor, which gives it the appearance of being encapsulated.

**Location.**—The *round-celled sarcomata* are situated in the periosteum, fascia, eye, antrum of Highmore, breast, testicle, and may occur in any of the connective tissues. The *giant-celled sarcomata* occur in connection with bone. The *alveolar sarcoma* develops in the subcutaneous connective tissues and in glands. *Melano-sarcomata* occur in the surface connective tissues. *Spindle-celled sarcomata* occur in the intermuscular septa, subcutaneous tissue, fascia, periosteum, interior of bones, eye, breast, and testicle.

**Characteristics.**—The characteristics of sarcomata are (1) Malignancy, (2) Occurrence, (3) Metastasis, (4) Infiltration, and (5) Degeneration.

**Malignancy.** The round-celled and spindle-celled varieties are of rapid growth and very malignant. Melanotic sarcomata are among the most malignant of tumors.

**Occurrence.** The tumor occurs at any age, but most frequently in early or middle life. They are prone to extend locally and after removal to recur locally. It is maintained by some surgeons that the tumor has never been successfully removed.

**Metastasis** may occur, but always by means of the blood-vessels. The neighbouring lymphatic glands are not enlarged unless the sarcoma becomes ulcerated. The tumor is generally localized and sharply circumscribed.

**Infiltration** takes place into the surrounding tissues and lymphatic glands. It disseminates by means of the blood-vessels, secondary growths occurring in the lung.

**Degeneration** in these tumors is common. Blood extravasations are frequent. The tumor rarely ulcerates, but more frequently it undergoes fatty degeneration or mucoid softening.

**Cancer, or Carcinoma.—Definition.**—Cancers are malignant tumors, consisting of masses of epithelial cells contained within alveoli and enclosed in masses of fibrous tissue. Like the tissue from which it is derived (epithelium) no stroma or connective tissue extends in between the individual cells. Cancers are the most atypical of all the neoplasms. The epithelial cells vary greatly in shape and size. One of its most peculiar characteristics is that the cells apparently grow the wrong way. Epithelial tissues grow towards the surface normally, but in cancer the tumor-cells grow down into the connective tissues in the interstices between the fibres and along the lymph spaces, sometimes forming distinct cell masses or cell nests, or at other times forming column-like prolongations. These columnar-like masses and cell nests are surrounded by dense layers of fibrous tissues, for when the cells grow down into the tissues they act like any other irritant and create a low-grade inflammation. This fibrous tissue surrounding the columns of epithelial cells extending into the subcutaneous tissues gives rise to the popular opinion that the cancer has roots. In some instances the cellular growth is very rapid and there is little production of fibrous tissue about the

cell masses. In this case the tumor is largely cellular. It is then soft and called encephaloid cancer. In other cases the tumor-cells proliferate less rapidly and there is an immense production of fibrous tissue about the cell nests, tubules, and columns of cells, when the tumor feels, because of the contraction of this fibrous tissue, like a hard nodular mass. This is called a scirrhus cancer. The blood-vessels of the tumor contain thickened walls, so that the wall of the artery is much thicker than in the normal tissues, whereas in the sarcoma the vessels have no walls, the blood being in actual contact with the tumor-cells. The fibrous tissue of the cancer, which is really inflammatory tissue, undergoes contraction, as happens in scars. This cuts off the nutrition to masses of the tumor, hence the frequency with which the tumor breaks down and ulcerates. This ulcerative process often extends into small blood-vessels, which accounts for the frequency with which cancer bleeds. The cancer spreads through the lymphatics and the lymph spaces and consequently the cells soon spread to the neighbouring lymphatic glands, causing enlargements. One of the most pronounced symptoms of cancer is *cachexia*. This cachexia is partly due to local ulceration and partly to the dissemination of the growth. The skin assumes a sallow, peculiar earthy color. The face is anxious and careworn and the body emaciated. This emaciation continues until the strength fails and the patient dies of exhaustion because of the general interference in nutrition, pain, mental anxiety, local ulceration, and hemorrhage.

**Epithelioma or Squamous-Celled Carcinoma** arises from the skin or mucous membranes. The cells of this tumor much resemble squamous epithelium. The alveolar characteristics of the tumor are not so marked as in acinous cancer.

**Location.**—Especially at points where the skin and mucous membranes meet—lips, nose, tongue, scrotum, or in scars, cheek, chronic ulcers, etc. In general this variety of cancer consists of solid columns of epithelial cells which have pushed down through the basement membrane and extend into the connective tissues.

**Symptoms.**—It usually begins as a warty tubercle which is soon converted into an ulcer with indurated, everted, and raised edges. It has a hard, warty, and irregular base. The tissues about are infiltrated and the neighbouring glands, through which the lymph channels of the affected area pass, become enlarged. On mucous surfaces the tumor may present a cauliflower excrescence. Sometimes there is a history of crack or fissure of long standing. Unless the epithelioma is removed while the disease is local it will recur in the neighbouring lymphatic glands or in some distant organ. Frequently cells become isolated from the columns which extend into the connective tissues. These cells multiply and form masses of cells which are moulded, because of pressure, into roundish columns, or they may extend a net-work through the tissues, making it often quite impossible

to remove all of the cancerous growth. This explains the frequency with which the tumor reappears after apparently all of the diseased tissue was removed. After removal, if the tumor recurs, it usually grows much more rapidly and more seriously affects the general health. The pain and ulceration, together with the growth of the tumor, bring about exhaustion, from which death is generally the result.

**Glandular Cancer, or Cylindrical-Celled Carcinoma.**—This tumor is derived from glands and surfaces covered with columnar or cylindrical epithelium. It is of slower growth than the other varieties. It begins as a warty outgrowth on mucous surfaces. It is most common in the rectum, but will occur in other parts of the intestinal tract or in the mammary gland.

**Structure.**—In structure the tumor consists of irregular tubules which are lined by columnar epithelium. These tubules are held together by a stroma or connective tissue which is more or less infiltrated by certain round-cells. The epithelial cells retain their shape more closely than any of the other forms of cancer. In very rapidly growing tumors the alveoli may become entirely filled with cells, when under such circumstances the cells are gradually destroyed. They infiltrate the surrounding tissues and affect the lymphatic glands and become disseminated into the internal organs. The liver is most frequently affected. With this tumor death occurs from obstruction of the bowel and from exudation and hemorrhage, due to the interference in the digestive process and to ulceration extending into the vessels. The general symptoms are of a malignant tumor.

**Acinous Cancer, or Spherical-Celled Carcinoma.**—These occur in three varieties, hard, soft, and colloid. The *hard* variety is medium sized, hard and nodular. Later they ulcerate and become disseminated through the body. Upon microscopic examination the alveoli in the older parts of the tumor contain cells undergoing fatty degeneration and in many cases the alveoli are shrunken and contain no cells, the cells having atrophied. It is around the circumference of the tumor where the characteristic microscopical structure is found.

**Location.** The usual locations are the breast, pylorus, and rarely in other situations.

The *soft acinous cancers* were called by the older writers encephaloids because of the resemblance to brain substance. The stroma is scanty in amount and does not contract like it does in hard cancer. The cells are prone to undergo fatty degeneration. On section they appear creamy colored or grayish-white. Frequently the cells may be diffuent. It is not unusual that ulceration may take place into the blood-vessels, leaving a fungating bleeding mass called fungus hematodes.

**Location.** Glands generally, as the breast, ovary, kidney, bladder, liver, testes. Secondary growths in other organs.

**Colloid cancer** is a term applied to any form of cancer undergoing mucoid or colloid degeneration. The colloid degeneration begins with the development of the cancer-cells; later the alveoli become distended with colloid material.

**Location.** The favorite location of this cancer is in the stomach, intestines, and ovary. It may occur in the breast or even in the throat.

*Differential diagnosis between benign and malignant tumors, sarcoma, carcinoma, and lupus.*

## BENIGN TUMORS.

1. Age. Appear at any age.
2. Growth. Generally slow.
3. Dissemination. Does not infiltrate the surrounding tissues nor does it disseminate through the lymph or blood stream.
4. Capsule. Generally encapsulated.
5. Adherent. Not adherent to the surrounding tissues.
6. Ulceration. Rarely break down and ulcerate.
7. Retraction. The tissues covering the tumor are not drawn and retracted.
8. Lymph glands. Lymphatic glands in the neighbourhood are not enlarged.
9. Pain. Generally not painful.
10. Microscopical appearance. Closely resemble the tissues from which they grow.
11. Metastasis. Never occurs.
12. Cachexia. No cachexia. Affects the body mechanically only.

## SARCOMATA.

1. Age. Appear at any age.
2. Growth. May be rapid or slow.
3. Dissemination. Surrounding tissues are more or less infiltrated and they disseminate by means of the blood-vessels.
4. Capsule. Sometimes encapsulated.
5. Adherent. Adherent to the surrounding tissues.
6. Ulceration. Rare.
7. Retraction. The tissues over the tumor are not so contracted as in cancer.
8. Lymph glands. Not enlarged unless the tumor is ulcerating.
9. Degeneration. More common than in cancer.

## MALIGNANT TUMORS.

1. Age. Generally appear late in life, except sarcoma, which may appear at any age.
2. Growth. Generally rapid, but may be slow.
3. Dissemination. Surrounding tissues are infiltrated and dissemination takes place through the lymph spaces and blood channels.
4. Capsule. Rarely encapsulated.
5. Adherent. Generally adherent to the surrounding tissues, and are more or less fixed.
6. Ulceration. Prone to break down and ulcerate.
7. Retraction. The retraction of the tissues over the tumor gives it a "bacon-rind" appearance.
8. Lymph glands. Lymphatic glands in the neighbourhood are very often involved, except in sarcoma.
9. Pain. Generally painful.
10. Microscopical appearance. Very atypical.
11. Metastasis. Secondary tumors usually occur in situ or in distant organs.
12. Cachexia. Pronounced cachexia and emaciation. Affects the body generally.

## CANCER.

1. Age. Rare before thirty-five.
2. Growth. Generally rapid.
3. Dissemination. Infiltrates the surrounding tissues and dissemination takes place by means of the lymphatics.
4. Capsule. Never encapsulated.
5. Adherent. Adherent to the surrounding tissues.
6. Ulceration. Very common.
7. Retraction. The tissues overlying the tumor have "bacon-rind" appearance. In cancer of the breast the nipples are retracted.
8. Lymph glands. Neighboring lymphatic glands are enlarged.
9. Degenerations are not common.

- |  |   |
|--|---|
| 10. Origin. Mesoblastic tissues.                         | 10. Origin. Always from epithelial cells.                                   |
| 11. Blood-vessels. Have no walls.                        | 11. Blood-vessels. Have distinct and thickened walls.                       |
| 12. Stroma. Stroma lies in between the individual cells. | 12. Stroma. Is around the cell masses and not between the individual cells. |
| 13. Metastasis. Distant metastasis not common.           | 13. Metastasis. Distant metastasis is common.                               |

## LUPUS.

- |   |   |
|---|---|
| 1. More frequently resembles epithelioma.                   | 8. Never appears like a fungus growth.  |
| 2. Does not precede the first evidences of disease-nodules. | 9. Its base is level with the surface.  |
| 3. Evidences of tubercular ulcer or diathesis present.      | 10. Generally not painful.  |
| 4. Occurs at more than one point.                           | 11. Cicatrization follows ulceration so that while ulcerating at one point it heals at another. |
| 5. No thickening around the ulcer.                          | 12. Hemorrhage is rare.   |
| 6. The areas coalesce.                                      | 13. It occurs at any age.   |
| 7. Abrupt and irregular borders. Has an "eaten" appearance. | 14. The discharge is generally not offensive.   |

**Treatment of Tumors.**—The principle of the treatment of tumors is the removing of mechanical obstructions and irritations which will occasion nutritional disturbances. Not all cases may be so cured, but many may be. Where the tumor is small, benign, pedunculated, or encapsulated and is superficial, it may readily be removed by a minor surgical operation, but where the tumor is large and can be reached only with considerable risk to the patient's health and life, manipulative treatment should be advised. In whatever part of the body the tumor is located, lesions will be found affecting the lymphatic stream, venous or arterial blood flow, or impinging upon the trunk or roots of the nerves of the part. Usually the favorable effect of the treatment will be evidenced within a short while. The tumor if hard will become softer, and if adherent, more movable. Absorption will gradually take place, following the correction of lesions and the removing of obstructions to the circulation. Not all tumors can be successfully treated. Many cases have been cured even after master minds have declared them incurable. This alone should commend the treatment in all cases before the knife is recommended. Should the tumor not yield to osteopathic treatment and should it manifest any malignant tendencies, or should it interfere with the general health, the knife should be resorted to and all parts of the tumor removed.

## CYSTS.

A cyst is a tumefaction made up of an enclosed sac filled with fluid, semi-fluid, or other material.

**Varieties.**—1. Retention. 2. Exudation. 3. Extravasation. 4. Dermoid. 5. Hydatid.

**Retention Cysts.**—A retention cyst is generally due to the secretions of a gland being retained within the tissues, with a consequent

dilation of the tubules or acini of the gland. The wall of the cyst is formed of inflammatory or fibrous tissue, while the lining of the cyst is generally flattened epithelium. There are several forms of retention cysts described, viz., (a) *sebaceous cyst*, due to the closure of the duct of the sebaceous gland, which opens into a hair follicle, and a consequent dilatation of the gland tubules because of the retained secretion. The cells continue secreting until the cyst attains enormous size. They are generally semi-fluctuating and movable. They are adherent to the skin. They can be distinguished from fatty tumors, inasmuch as the tumor will not slip underneath the fingers. These tumors may undergo numerous secondary changes. Occasionally when the tumor is opened, the contents will be found to be extremely offensive, or the more liquid portion of the contents may exude and the remainder become hardened, or the cyst may become inflamed, causing suppuration and ulceration, or a sinus may result. Wounds may heal and cysts reappear, or while the sinus still exists, granulation tissue may form within the tumor, making the mass resemble an epithelioma. The *treatment* is often surgical. The tumor should be laid open and the contents evacuated and the sac scraped out. The wound is allowed to heal by granulation.

(b) **Mucous Cysts.**—These occur frequently in the mouth, or they may be due to the distension of Bartholin's glands at the entrance of the vagina. The walls are usually thin and they may attain great size.

**Treatment.**—Lay the tumor open and cauterize the interior.

There are other forms of retention cysts, such as those formed by the closure of Wharton's duct—ranula, encysted hydrocele and galactocoele.

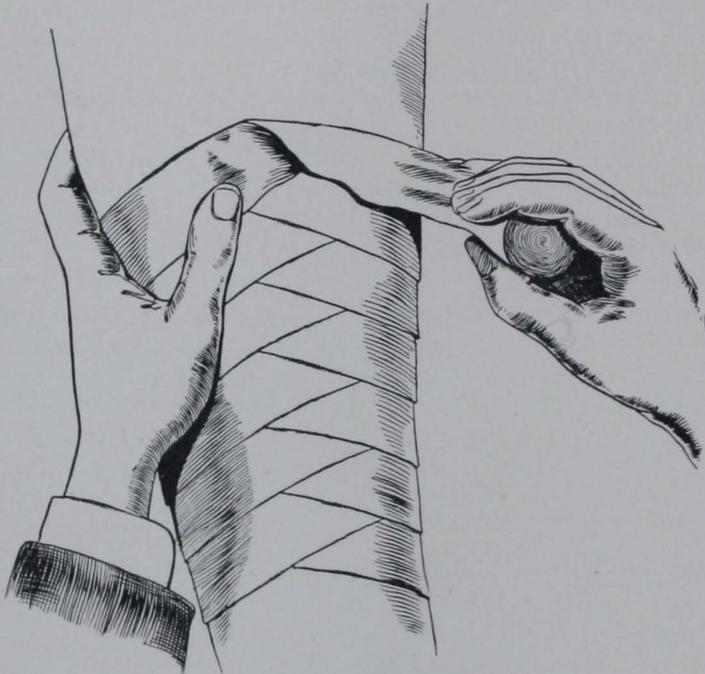
**Exudation Cysts.**—Exudation cysts are produced by the exudation of fluids into cavities which have no ducts or outlets. Examples of these cysts may be found in the ovary where distension of the Graafian follicles may occur, or in the bursae over the olecranon, or about the knee, or ganglia which happen in connection with extensor tendons on the back of the hands. These will be described under "Diseases of regions."

**Extravasation cysts** are produced by the extravasation of blood into the closed cavities of the body or into connective tissue spaces. They are called hematoceles. These may occur in the pelvis, tunica vaginalis, beneath the scalp or following the rupture of an artery within the skull.

**Dermoid cysts** are of congenital origin and are formed by the inclusion of a portion of the epiblastic tissues within the mesoblastic. In after life these inclusions develop epithelial tissues. There are certain of the dermoid cysts which can not be explained in this manner, as those containing hair, bone, cartilage, teeth, etc. These are said to be produced by the inclusion of blighted ovum in a part of the embryo.

By others it is said to be due to the development of atrophied fetal structures. Dermoid cysts occur in the tunica vaginalis, in the middle line of the neck, arising from the thyro-glossal duct, from the parovarium near the ovary, or they may arise from the ovary or testicle. Other forms of congenital cysts may occur in the axilla and scrotum. Dermoid cysts are the most common. In these are found all the structures forming the true skin and its appendages; such as hair, sebaceous glands, teeth, nails, etc. The contents vary, but consist for the most part of secretions of the glands in the cyst wall.

FIG. 7.



Method of applying a spiral reverse bandage.

The *treatment* of these cysts is most likely surgical, and where possible they should be removed.

**Hydatid or Parasitic Cysts** are produced by the *tenia echinococcus*, one of the forms of tape-worm or cestoda. The worm normally inhabits the intestine of the dog, but it sometimes gets into the intestine of the human from uncooked garden vegetables, the parasites having been deposited on them from the excreta of the dog. The ova taken into the system, hatch out and develop and the embryo makes its way by some channel to the liver or to some other organ, where the development of the embryo results in the production of a cyst.

The *diagnosis* of the cyst varies according to the locality in which the cyst is found.

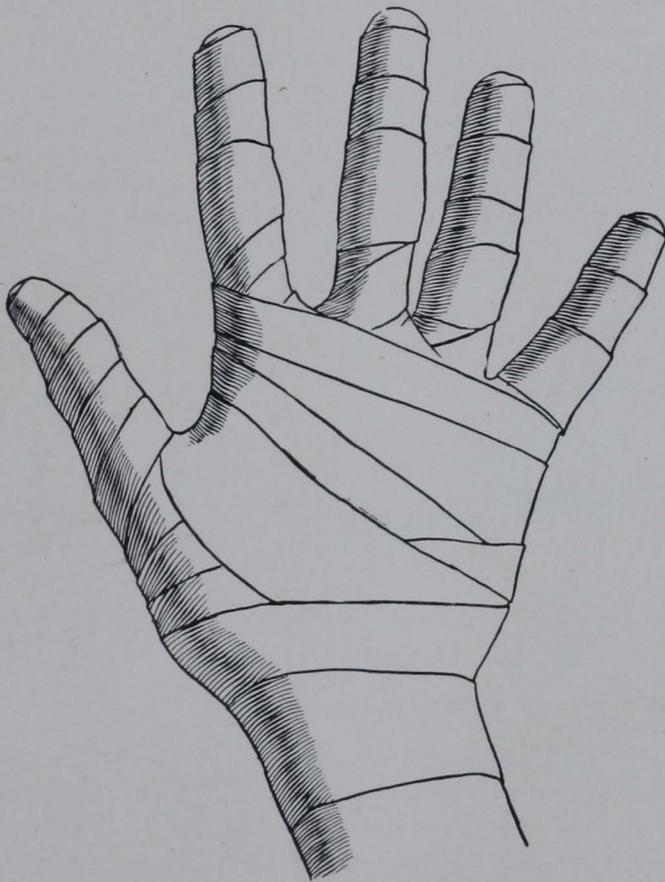
The *treatment* is entirely surgical. Puncture of the cyst is sometimes

attended by urticaria. Peritonitis and general infiltration of the tissues will produce death in some cases. Fortunately the disease is rare.

In general, cysts should be treated on the same principle as tumors.

After a fair trial of the treatment, if the cyst does not recede, operation may be advised.

FIG. 8.



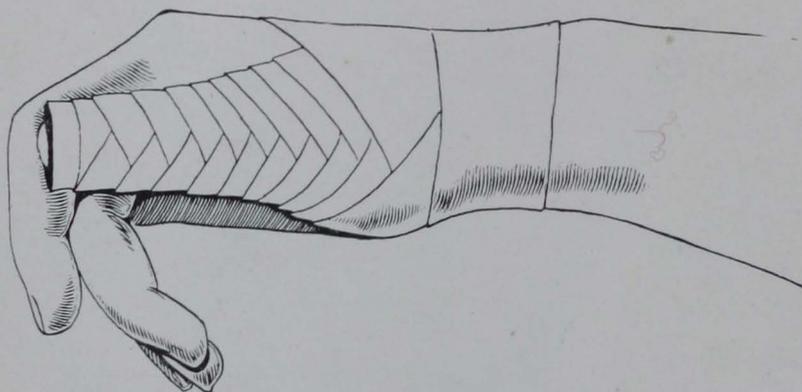
The gauntlet bandage for the fingers and hand.

### BANDAGING.

Bandages are used to hold splints and dressings in place, to support parts, protect injured structures, and assist the return circulation. The materials usually used are unbleached muslin, gauze, crinolin, flannel, or rubber. Fabrics impregnated with plaster-of-Paris and starch paste, are often used as fixed dressings where support and immobility must be maintained. To hold surgical dressings in place the muslin or crinolin bandages are best. To assist the return circulation, a wet flannel or a rubber bandage should be used. A figure-of-8 bandage

is best and, if possible, should always be applied. It gives the most uniform pressure. The spiral reverse bandage is easy to apply, but is not so satisfactory. In applying the bandage, it should always be *rolled out*. It should be carried twice directly around the member at the beginning to anchor the bandage, after which the figure-of-8 turns may be made. Care should be taken to *keep the lower edges of the turns of the bandage parallel*. A part should always be bandaged, if possible, in the direction of the return circulation. Each turn of the bandage should be drawn equally tight and should cover one-half of the previous turn. To do this the bandages should consist of strips of from one to nine yards in length and should be rolled up into a single or double roller. In bandaging the fingers or thumb, a figure-of-8 bandage is used. Successive turns may be made over the end of the finger, while afterwards the bandage is carried around the finger to hold the turns

FIG. 9.



Spica bandage of the thumb.

in position. This same method may be used in amputation stumps. For the knee or elbow a figure-of-8 bandage is best. The first turn of the bandage is made opposite the joint with succeeding figure-of-8 loops above and below. In bandaging a shoulder or thigh, a spica bandage is applied. The bandage is begun at the middle of the arm or the thigh and carried upward by figure-of-8 turns. A head bandage is best applied by means of a double roller which unrolls in opposite directions. One roller is carried around the head as successive turns from before backward are made by the second roller. The over-and-over turns may be made from before backward, or from side to side. The ends of the bandage must be firmly anchored by safety pins.

The figure-of-8 bandage is also useful in bandaging up an inflamed breast. A posterior figure-of-8 bandage is quite serviceable in case of fracture of the clavicle.

Velpeau's Bandage.—A bandage three inches wide and nine yards long is required. Pad the axilla on the injured side and place the hand

on the sound shoulder. The bandage is begun on the scapula of the sound side and carried across the back over the injured shoulder, down the front and outside of the arm, turning upward toward the axilla to the starting point. A second turn is made to fix the bandage. The third turn is made circularly around the chest and over the arm on the

FIG. 10.



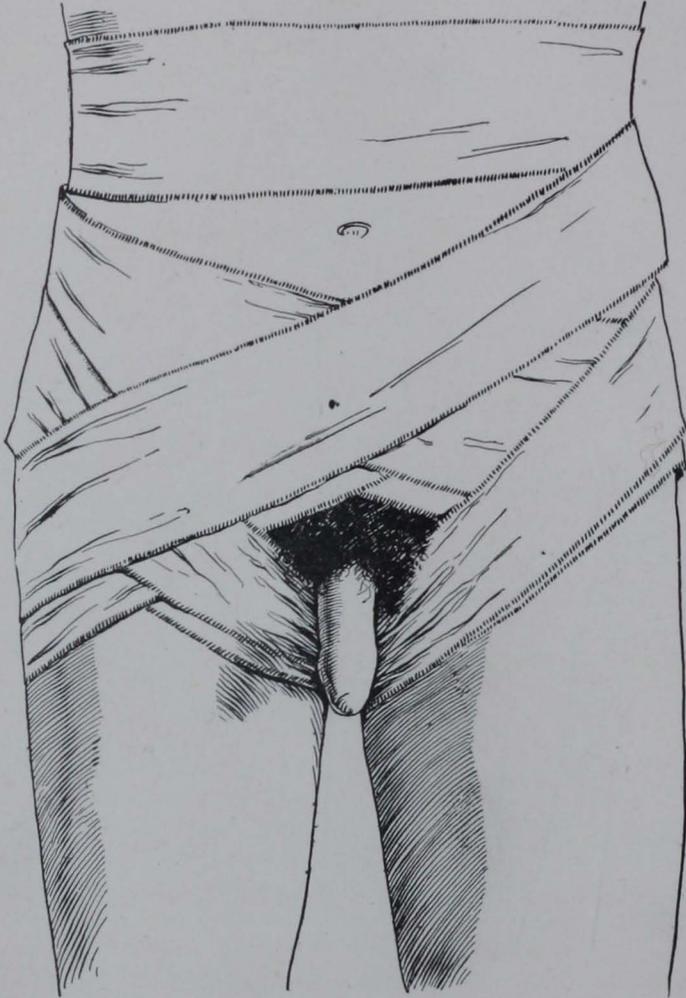
Spica bandage of the shoulder.

injured side, while the fourth turn is as the first. These turns are alternated so as to resemble an ascending spica (see figure). The turns of the bandage should be fastened over the arm. In bandaging the foot, care should be taken to cover all parts of the member by regular figure-of-8 turns. If there is faulty circulation the bandage should be carried beyond the calf of the leg. Barton's bandage, or a figure-of-8 of the lower jaw, is useful in case of fracture of the lower jaw. A crossed

figure-of-8 bandage is useful for both eyes, while single turns are sufficient for one eye.

A many-tailed bandage is made by means of a piece of cloth the width of the part to be bandaged and in length more than twice its cir-

FIG. 11.



Spica bandage of the groin.

cumference. The ends of the piece of cloth are torn into strips three inches wide, the torn part of the bandage comprising about half its length. These opposite strips of the torn ends are then tied together around the member to be bandaged. This bandage is suitable for the thigh or abdomen.

The "T" bandage is suitable for the perineum. It consists of a cir-

cular strip extending around the body and a vertical strip attached behind, passing between the thighs and fastened to the circular strip in front.

#### Fixed Dressings.

**Starch Paste Dressing.**—This bandage is made by means of a many-tailed bandage, pasteboard, and starch paste made by cooking a little flour or starch into a paste. The strip of pasteboard is smeared on one side with the starch paste and then applied to the middle of the many-

FIG. 12.



Head bandage applied by means of a double roller.

tailed bandage. This is then applied to the injured member after it has been suitably enveloped with cotton for protection. Several strips of pasteboard may be used and they may be placed on all sides of the member. If two layers of the pasteboard are used, a bandage of great strength may be made. The tails of the bandage are tied around the member. The bandage has the advantage that it can be enlarged to accommodate swelling. This bandage is preferred by Dr. Still.

**Plaster-of-Paris Dressing.**—A piece of crinolin four yards long should be torn in strips from three to six inches broad, depending upon the part of the body upon which the dressing must be applied. If it is

on the thigh it should be torn in strips six inches wide, but if for the lower leg or foot, three or four inches wide may be sufficient. Into this crinolin should be rubbed dry powdered plaster-of-Paris, which can best be done by heaping the plaster on a table, taking the bandage before it is rolled up and with a thin board or table knife, the plaster-

FIG. 13.

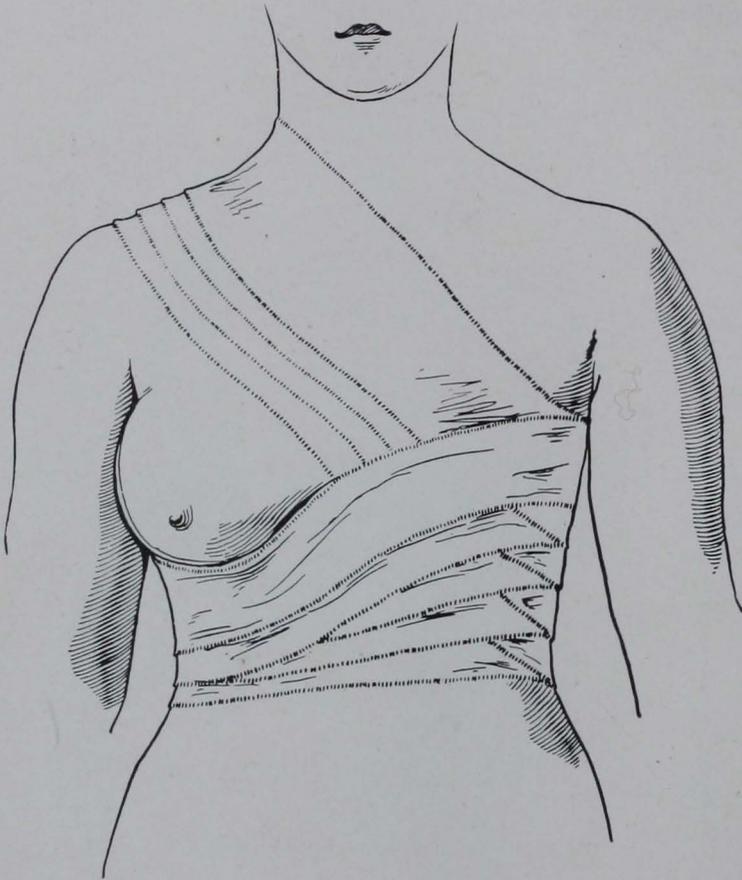
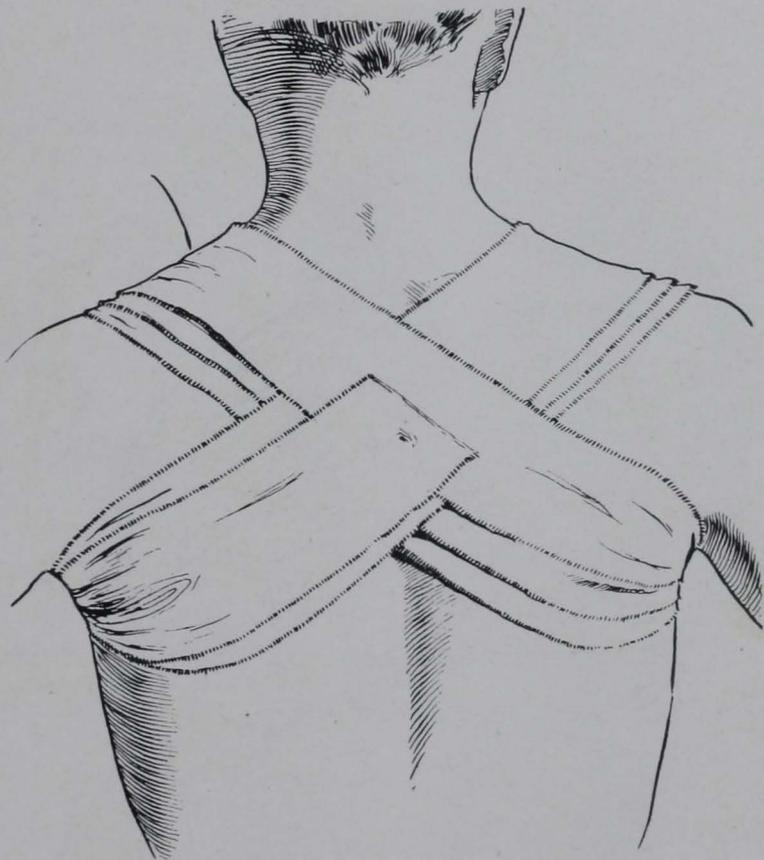


Figure-of-8 bandage applied to support the breast.

of-Paris may be pushed along over the bandage, an effort being made to scrape from the bandage as much of the plaster-of-Paris as possible. As the plaster-of-Paris is scraped off, the bandage is rolled up so that when the bandage is entirely rolled up it is thoroughly infiltrated with the dry plaster. This may be wrapped in oiled paper and kept ready for use. For fracture of the tibia and fibula at least one dozen of such bandages are required. Providing the limb has been put in proper position with the bones in apposition, the limb must be enveloped in lamb's

wool, surgeon's cotton or lint, and a roller bandage applied evenly over all. The cotton should be carried higher than the bandage. The plaster-of-Paris dressing is now immersed in warm water in which there has been a small quantity of common salt dissolved. Powdered alum will serve the same purpose, viz., to make the plaster set more quickly. When the bandage is thoroughly soaked, it may be applied as an ordinary

FIG. 14.

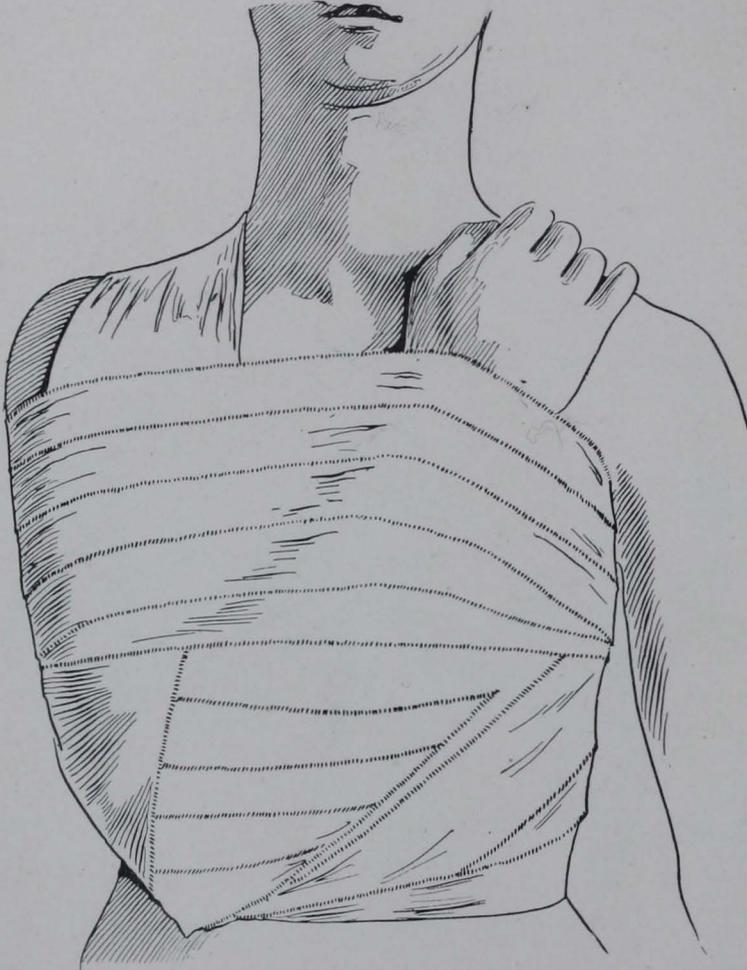


A posterior figure-of-8 bandage. Useful in fracture of clavicle.

bandage. Three or four layers of the plaster bandage should be applied. In case of fracture of the femur, a counter-extending apparatus may be applied before the leg is enveloped in cotton-wool. After the dressing is applied, extension and counter-extension should be kept up until the plaster sets, which may be within an hour. If the plaster bandage has been applied too tightly and interferes with the return circulation, as soon as it sets it may be cut along one side and pulled open so as to allow the blood to circulate freely in the limb. On the outside of this, a roller bandage may be put on to draw the plaster sufficiently close

to the limb to maintain immobility. In this condition the plaster bandage forms an excellent adjustable splint. The indications that the bandage is too tight are signs of obstructed circulation in the extremity, together with numbness and great pain. These demand immediate attention. The plaster dressing is of especial advantage in

FIG. 15.



Velpeau's bandage.

what is called the ambulatory method of treatment of fractures. It is bulky, cumbersome, and many times unclean.

### ANESTHESIA AND ANESTHETICS.

Anesthesia means insensibility to pain. The word was coined by Dr. Oliver Wendell Holmes in November, 1846. It may be local, when produced by applications or injections or sprays of cocain, eucain,

ethyl chlorid, etc., or general when produced by the inhalations of ether, chloroform, nitrous oxid, ethyl chlorid, etc. Before the discovery of these drugs, alcohol and opium, together with the application of cold, were used for the purpose of deadening the sensibility. Ether was first discovered by Dr. Morton, a dentist in Boston, in September, 1846, while chloroform was discovered by Simpson, of Edinburgh, in 1847. Ether is the safest of the general anesthetics. The death rate of its administration is variously estimated by different observers, from 1 in 16,542, to 1 in 23,204, while in chloroform the death rate is 1 in 5,860, to 1 in 3,258. These proportions are given from more than one-half million collected cases.

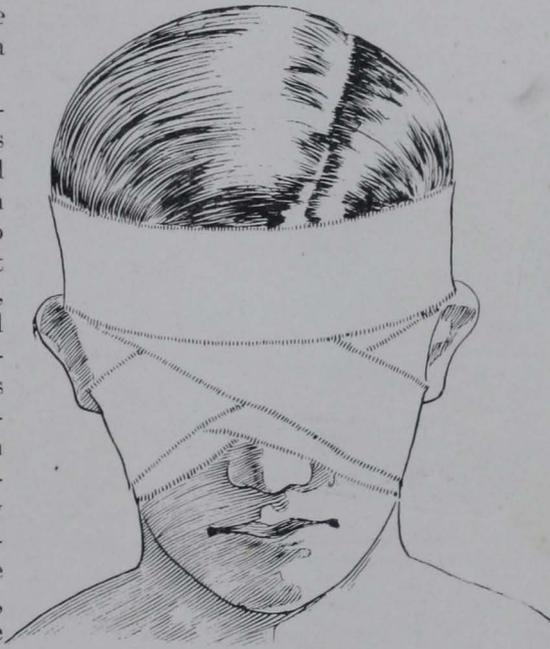
More than forty thousand etherizations have been collected without a single death reported.

**Ether.**—The chief objections to its use are its irritating qualities and inflammability (which makes it dangerous to use at night), while it often produces nausea, vomiting, and cerebral excitement. In administering an anesthetic it is best to have a third person present, inasmuch as curious mental impressions may be retained by the patient after recovery. In general, the heart, lungs, kidneys, great vessels, and the nervous system should be observed before the anes-

thetic is given. The patient should have nothing to eat for four hours previous. It should be looked to that the patient does not have false teeth, a chew of tobacco, or other objects within his mouth. The clothing should be loose about the chest. The anesthetic should always be given while the patient is in a recumbent position, with the head low. The anesthetist should have a mouth gag, and a pair of forceps handy with which to pull out the tongue if necessary. Ether is best administered by means of a cone which is made of several thicknesses of newspaper and a towel.

Chloroform is best administered by means of an Esmarch's inhaler, or a paper cone, containing within its apex a pledget of gauze, or a small handkerchief. The vapor of chloroform is more grateful, the

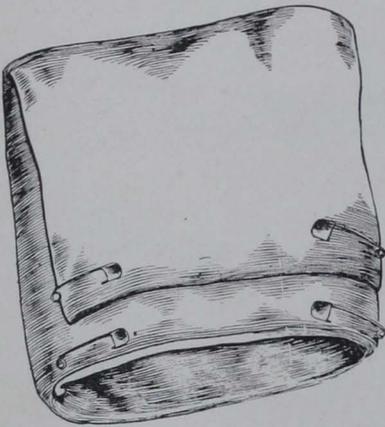
FIG. 16.



Method of bandaging both eyes.

patient goes under the anesthetic easier and quicker and it is less irritating. It should be given when an anesthetic is required in children under ten years of age, or in elderly people over sixty who have no heart disease. It should be given in kidney diseases, diabetes, and in bronchial inflammations. It is used in labor because of its quick action. In operations on the mouth and nose, or in operations for cleft palate, it is best. Ether should be used in all other cases. In the administration of ether, the cone should be so held over the patient's face that the proportion of admixture of gas and air will be five per cent. of the air to ninety-five per cent. of the vapor, while in chloroform just the opposite condition is desired—from five to ten per cent. of the vapor of chloroform should be mixed with ninety-five to ninety per cent. of air. Operable anesthesia is reached just after the conjunctival reflex has

FIG. 17.



The towel and paper cone suitable for administering ether or chloroform.

been paralyzed and before stertorous breathing occurs. The pupils should always be watched. Sudden dilatation of the pupil is grave. It is more essential to watch the respirations than the circulation. Because of the irritating qualities of the anesthetic, the patient may hold his breath and thus deceive the anesthetist. Especially is this true in the second stage of anesthesia, which is accompanied by excitement and muscular rigidity. It is essential that the drug should not be pushed under such circumstances, especially if the patient is strong and vigorous. During the early stage of excitement, the patient may shout, sing, fight, and swear, and it is necessary to give the drug easily and carefully, but surely, paying attention strictly to the condition of the patient. By touching the conjunctiva it will be observed that the reflex has disappeared. The patient is then ready for operation. Just enough of the drug should be given to keep the patient in this condition. Some operators give chloroform first, and after complete anesthesia ether is given, inasmuch as it stimulates the circulation. The face and neck are usually warm, moist, and flushed during the administration of ether. Not so with chloroform. Accidents may happen during the administration of anesthetics, the first and most important of which is the arrest of respiration. The tongue should at once be pulled out of the mouth, the drug removed, and the head fully extended in order to raise the epiglottis. At this same time the patient should be everted and artificial respiration performed by Sylvester's method. Laborde's method of rythmical traction of the tongue is of advantage. The tongue should be drawn out of the mouth sixteen times per minute,

while in Sylvester's method, the manipulation should be done with the same frequency. The patient must be placed with the head low, while the flexed arms are compressed against the chest to expel the air, then extended above the patient's head to raise the ribs. These alternate motions must be done so as to simulate respiration. Should the circulation fail, the patient should immediately be suspended by his feet while the vasomotors are stimulated.

### PROCESS OF REPAIR.

The reparative process is, in many respects, similar to the inflammatory process. Having removed the irritant from the tissues, as will, more than likely, sooner or later occur in the history of an inflammation, the return of the tissues to the normal condition, or as nearly the normal as is possible, is termed the reparative process. It has been falsely stated by some writers that it is a process taking place in aseptic inflammation. Obviously such conditions never exist about the human body. The reparative process differs according to the nature of the wound, the tissues involved, and the nature of the irritant in question. These differences are minor. Where pus formation occurs, the reparative process is greatly modified and thwarted because the tissues must not only repair the injury, but must get rid of the irritant (micro-organism). In reference to wounds the reparative process has been divided into healing by *first* intention, by *second* intention, and by *third* intention.

**Healing by First Intention.**—In healing by first intention, the reparative process in the open wound begins just as soon as the tissues have recovered from the injury and the hemorrhage has been arrested and the cells are again receiving their proper quota of nutritious materials. If the edges of the wound are coaptated and the suppurative process is not set up, the inflammation will be slight and just sufficient to bring about adhesion of the tissues. During the first day or two, there will be a little redness extending slightly into the surrounding tissues and there will perhaps be a little swelling and a slight elevation of the local temperature, but the wound will be devoid of pain and only slightly tender to pressure. An effort to pull apart the edges of the wound will show that adhesion has occurred and in a few days the union is formed. Along the line of injury there will be a number of new cells formed which assist in welding together the tissues. It is hardly likely that in any case there is absolute adjustment of the tissues, as fascia to fascia, muscle to muscle, etc., therefore, even in healing by first intention, there would be some need for the formation of new tissue, but as before mentioned, this new formation is of the slightest amount possible. The tissue changes occurring in healing by first intention are worthy of note. Immediately in the surrounding area there is a dilatation of the vessels, stasis occurs, proliferation of the connective-tissue cells and the escape of the leukocytes and serum from the capillaries.

They infiltrate the surrounding tissues and fill up the lymph spaces. Proliferation of the connective-tissue cells results in the formation of new round cells which crowd into the mass of coagulated fibrin which fills up the slight spaces between the edges of the injured tissues, so that in a few days the entire wound is filled with new cells (granulation-tissue cells). The inflammation extends but a short distance back from the wound. The coagulated lymph, blood, and serum, which first filled up the wound and which later have become invaded by the granulation-tissue cells, now become absorbed. The inflammatory reaction becomes less and finally ceases, so that if in a few days a section of the part be made, it will be found that a layer of small round cells unites the edges of the wound. This mass of small round cells is permeated by capillaries which have stretched across the wound and serve the purpose of furnishing the new cells with nutrition. These capillary loops are thrown out coincident with the proliferation of the resident connective-tissue cells. This vascularization of the tissues is one of the characteristic parts of the process and furnishes the cause for the color of the scar immediately after the wound has healed. These round-cells which form the scar now become differentiated into fibrillar connective tissue which, like other fibrous connective tissue, contracts. The cells, at first elongated and spindle shaped, become wavy. This contraction of the scar squeezes the blood out of the capillary loops, when the scar is changed from a pink color to white. The fibrous tissue formed is generally in excess of the required amount, but absorption of the excess of new formation takes place and in a few months or years after, the scar will depreciate materially, or in some cases apparently disappear. After union takes place, if the wound be an incised one, only a faint streak remains to mark its site, and as time goes on this line changes, at first pink, later becoming white and after awhile it may entirely disappear so far as external appearances are concerned. There are few or no constitutional symptoms following or attending the repair of wounds in this manner. This is the condition which should be aimed at by every physician in the treatment of wounds. Considering that large bodies, such as bullets, splinters, thorns, or the penetrating object which produced the wound, have been removed, the only other agency, outside of constitutional defects or irregularities of circulation, etc., which would prevent the union by first intention, is the presence of micro-organisms. Other things being equal, the micro-organisms are the objects which prevent union by first intention, or in other words, cause immoderate inflammation or produce suppuration, therefore, before the wound is coaptated it must be rendered as nearly aseptic as possible. There are cases where coaptation of the wound has never been obtained and the wound having become filled with blood, heals up. This is said to be one special form of healing by first intention, or healing by blood clot. There is another method which properly belongs to healing by first intention—it is where, after a slight wound, a scab is formed and without suppuration the healing takes place under-

neath the scab. This is properly healing by first intention without any destruction of the tissues.

The conditions preventing union by first intention may be summarized as follows:—

1. Extensive contusion and destruction of the tissues.
2. Presence of septic material or foreign bodies.
3. Diminished vitality of the tissues because of debility or the use of alcohol, or the presence of diabetes, bad hygiene, etc.
4. The parts not having been kept at rest.
5. Insufficient drainage.

All of these conditions operate to permit of infection, and if infection occurs, the granulation tissues will be converted into pus, when healing by second intention will be necessary

**Healing by Second Intention.**—In healing by second intention, either coaptation of the wound has not taken place or infection has occurred through the operation of some of the above named conditions. If pus forms because of insufficient drainage, sepsis, etc., after coaptation of the wound, there may be a reaction quite similar to septic intoxication. Many times this will occur and has led to the popular belief that wounds may heal too quickly. If a wound is completely healed, under no circumstances may the repair take place too quickly, but the trouble is, because of the vascularity of the deeper layers of the true skin, it becomes glued together before the connective tissues beneath heal. The presence of foreign bodies, or the effusion of fluids which later become septic, cause pus formation. The tissues become distended and the wound opens and discharges pus. If the wound is large and the pus formation great, there may be a severe systemic reaction. After this change has taken place, the wound must then heal by second intention. If there has been extensive destruction of tissue or a mass of the tissue dies because of the injury, as soon as the hemorrhage is arrested and the wound has been cleansed, the connective-tissue cells begin to proliferate. The area becomes very vascular because of the dilatation and the formation of new vessels. The round cells, the source of which is the resident connective-tissue cells, increase and multiply and fill up the wound from the bottom. Capillary loops are formed which extend out into these layers of granulation tissue which are formed one above the other, extending from the bottom of the wound towards the top. When the wound is filled, the surface epithelium creeps out over the top from the surrounding epithelium. This epithelium is usually dwarfed, most likely because of an insufficient blood supply, so that the epithelial covering of a scar is not like that over the surrounding healthy tissues. After healing has taken place the scar, which is now red and elevated, grows smaller because of contraction. This cicatricial contraction is due to the differentiation of the round cells, which become spindle-shaped and long, and

afterwards contract into wavy bundles. Where the scar is extensive, this cicatricial contraction may produce great deformity, often rendering a member useless. In wounds through the cheek, cicatricial contraction and scar formation, if there is not good coaptation of the wound, may prevent the person from opening the mouth. Cicatricial contraction may bind down the tendons of the hand so as to render it useless. In burns about the face, the cicatricial contraction may distort the features. Should it happen that there is much destruction of the tissues, healing will not take place until all of the destroyed tissues are removed. These are removed by process of ulceration and gangrene.

**Healing by Third Intention.**—Should it happen that the wound is so extensive that it may not be coaptated, healing by second intention will continue and after a time the wound will become comparatively small. It may then be possible to coaptate the edges. Considering that the surface of the wound has been rendered aseptic, if the edges of the wound are brought together and held in apposition by some means, union of the two granulating surfaces will take place readily and quickly. This is healing by third intention.

#### Repair of Special Tissues.

**Epithelium.**—The repair of epithelium is generally complete. The new cells are derived from the epithelium at the margins of the injury by a process of division and subdivision, the cells spreading out over the basement membrane, but if the injury extends into the subepithelial tissues, a scar will be formed.

**Skin.**—Repair of the skin is accomplished by scar formation. Fibrous tissues take the place of the other structures. No nerves are found in the scar. After a time even the blood-vessels disappear. Hair, sebaceous glands, sweat glands, and the other appendages of the skin are not reformed. The rete Malphigii is not reformed, which likely accounts for the fact that the epithelium over the scar in the skin is imperfect. Inasmuch as a scar contains a poor epithelial covering, few vessels, few or no lymphatics, and no nerves, it is liable to injury.

**Fascia and Tendons.**—The repair of fascia means practically regeneration, inasmuch as it consists almost entirely of fibrous tissue. The repair of tendons is not quite so complete, the scar always remains in evidence, but a scar formation may fill up a considerable gap between the divided ends of the tendons, producing an excellent result, even though the tendon is somewhat defective.

**Muscle.**—Muscular tissue is only repaired by means of scar tissue derived from the endomysium, perimysium, and epimysium, or from the endothelial tissue elements. Regeneration of the muscles may follow to a limited extent, but as a general rule, no highly organized tissues, such as muscle, will regenerate. It is possible where there is absolute coaptation of muscle fibres, that union by adhesion will take

place. According to some writers, severed ends of muscle fibres die and the ends of the damaged muscle cells break up into spindle-shaped fragments, which undergo fatty degeneration and totally disappear by the twenty-first day. The disappearing fibril is then replaced by a bundle of longitudinally striated fibres, which are differentiated from the muscle nuclei. The growth of the muscle fibre into the granulation tissue and the disappearance of the destroyed muscle tissue, begin about the sixth day. The outgrowths of muscle may bifurcate and terminate in club-shaped extremities. The longitudinal striations may appear as early as the second week. The new muscle filaments which are formed, should this occur, interlace and extend in various directions. The interlacing of the fibres from the opposite side of the wound continues until the muscle is made thoroughly strong, when the interlacing fibres are gradually absorbed and the muscle seems to return to the normal condition.

**Blood-Vessels.**—The repair of blood-vessels frequently depends upon the organization of thrombi. A wound of an artery may heal by the formation of cicatricial or scar tissue. More or less arrest of the blood current is necessary for this to take place. If a thrombus forms it may undergo secondary changes. Capillaries are developed by the sprouting out of the endothelial cells. These outgrowths become united with other outgrowths, forming loops. The cells of these loops become hollowed out, in some manner, forming capillary loops.

**Nerves.**—Under proper circumstances the repair of nerves (nerve fibres) is complete. The immediate union of nerve fibres with the restoration of their power is said to have occurred clinically, but as yet has never been done experimentally. When nerve cells are destroyed, they are not reproduced, but when the fibre is destroyed, it may be regenerated or reproduced. When the fibre is cut off, the whole distal end of the nerve dies and degeneration of the proximal end takes place back to the first node of Ranvier. Regeneration of the nerve then takes place by the outgrowth of the proximal extremity. Zeigler maintains that the distal segment takes an active part in the regeneration of the nerve. The process which most likely takes place is as follows: In four or five days after section, the myelin sheath becomes segmented and the axis cylinder divides up into fragments in the distal portion of the nerve. As early as the seventh day, active proliferation begins in the neurolemma with migration of the newly formed cells, several occupying one internode. During the following week the myelin sheath and fragmented axis cylinder become absorbed and are completely removed by the fourteenth day. The nuclei in the internodes then acquire an investment of protoplasm. This process continues until a single-celled protoplasm fibre with imbedded nuclei is formed. It sometimes happens that more than one sheath and more than one protoplasmic fibre may occupy the old sheath. The fibre now grows down through the newly formed sheath and the function begins

to return by the twenty-first day and is complete in eighty days. These are the results of experiments upon dogs under favorable circumstances.

**Bone.**—The repair of bone takes place in the same manner as in soft tissues. Ossification follows in the soft callus, or in other words, the granulation tissue is converted into bone in much the same manner as bone is formed in cartilage or in membrane. The union may be sufficiently complete under very favorable circumstances, that it would be difficult to determine the point at which the fracture occurred.

## WOUNDS.

**Definition.**—A wound is a solution of the continuity of the living tissues. In general, wounds may be divided into two great classes, open and closed. Open wounds are those in which there has been a solution of the continuity of the surface or the skin is broken. Wounds vary according to the instruments which produce them, the tissues affected, and the amount of force used. A slight force may produce an extremely severe wound in some tissues, while in others the effects would be but slight. The amount of damage inflicted by an object is by no means apparent by the slight wound at the surface, but on the other hand, the gravity of the wound will depend largely upon the nature and extent of the wound and the tissues involved.

**Effect.**—The effects of wounds are (A) Local and (B) General. The local effects are (1) pain, (2) hemorrhage, (3) retraction of the edges of the wound, and (4) more or less interference in function.

**Pain, Retraction of Edges, etc.**—The pain occasioned by a wound will depend upon the nature and location of the wound. In contused wounds, the bruising of the tissues will destroy the sensibility. More or less contusion attends a gunshot wound, and in moments of excitement, persons may not discover that they have been injured, unless a nerve trunk or some other vital structure has been injured. The pain may be quite severe, due to irritation of the peripheral nerves, or it may subsequently become more severe, due to secondary changes taking place in the wound, e. g., sepsis. Inflammatory changes will cause pressure on the terminal nerves. Pain at first acute will perhaps be converted into a dull ache, and if severe inflammation follows, the pain may become intense. Sometimes retraction of the edges of the wound will be very great, especially if muscular tissue has been severed. If the wound is directed across the cutaneous muscular fibres, instead of parallel to them, the retraction will be much greater. The interference in function will depend upon the extent of the injury and the structures involved.

The *General Effects* of wounds are (1) shock, and (2) hemorrhage.

**Shock.**

Shock constitutes the systemic effect of severe injury in which vasomotion and inhibition are profoundly disturbed.

**Cause.**—It is produced by the profound effects of afferent impulses on the centers. There is a marked fall of blood pressure, due to temporary paralysis of the splanchnic area. This results in the engorgement of the abdominal viscera and consequent anemia of the nerve centers. Where it is suddenly fatal, it is perhaps due to the effect of severe impressions directly on the centers or to the effect on certain nerves, such as the pneumogastric. Death is said to result in such cases from inhibition. Shock is more disastrous in old people and in the debilitated or in victims of heart disease, diabetes, or alcoholism. Injury to the viscera, or even simple exposure of the intestines to the air, as in the opening of the peritoneal cavity, very often occasions great shock. Operations on the urethra or injury to the testicle or ovary or uterus are attended with great shock. Burns over considerable areas, even though it is but an injury of the epithelium, may cause fatal shock. Especially is this true where it involves the trunk. Irritant poisons or profound mental emotions may superinduce fatal shock. Prolonged anesthesia or the removal of a tumor or a considerable quantity of fluid from the abdominal cavity may bring about considerable shock. The constant abstraction of the body heat may occasion great shock. Hemorrhage will cause shock according to its severity.

**Symptoms.**—The onset of shock is sudden and is generally easily recognized. It may be confounded with hemorrhage. The symptoms may be thus summarized:

**Mental.**—The person may be conscious or semiconscious, depending upon the severity of the shock or upon its prolongation.

**Skin.**—The person is blue, the lips are blanched, and the skin is generally covered with a cold, clammy sweat. The extremities are especially cold.

**Circulation.**—The heart is quick, pulse feeble and fluttering. Very often the pulse can not be detected in the extremities. It may not be appreciable in the radials.

**Temperature.**—The temperature is generally subnormal.

**Eyes.**—The eyes are half-closed, lusterless, and glazed. The pupils are dilated and react slightly to light.

**Respiration.**—The respiration is shallow, quiet, and slow and may be of the Cheyne-Stokes character.

**Muscular System.**—The muscles are usually relaxed. There may be more or less muscular tremor. The sphincters yield and there may be involuntary actions of the bowels and bladder. There may be nausea and vomiting. In severe forms of shock, the urine may be suppressed and the patient subsequently die of uremia. The symptoms

may come on with such sudden onset that the patient will die of syncope, or if the shock is prolonged, the patient will go into a semiconscious or delirious state, followed by collapse. Reaction may be established. This will be attended by the color returning, the skin becoming hot, face flushed, and the temperature rising to normal, or perhaps slightly elevated. The bowels will be confined, the urine scanty and high-colored and the patient will feel feverish. The pulse becomes full and strong. The secretions will be established slowly.

**Treatment.**—The treatment of shock is to first remove the cause. If it is hemorrhage, this should be at once arrested. If it is due to an anesthetic, it should be withdrawn and the patient given plenty of fresh air. If it is due to exposure the person should be protected. Often in cases of operation the shock may be brought about partly by exposure of the patient, the surface of the body becoming chilled. If the shock is due to the presence of a dead limb, which may sometimes occur, the limb should be amputated. If due to the presence of a fracture or dislocation, this should be reduced and the member put in an easy position as soon as possible. Never administer morphine in case of shock, even if the shock is largely brought about by pain. Bandage the limbs with hot flannels; especially should this be done if the shock is brought about by hemorrhage. Wrap the patient in hot blankets. Hot water bottles should be applied over the heart and generally about the body. If the shock is severe, hot fluids, such as hot coffee, etc., may be given. Artificial respiration should be kept up. The head should be lowered to allow the blood to get to the centers. Enemata of hot normal saline solutions may be given. The solutions should be heated to 110 degrees F.

**Osteopathic Measures.**—It is of the greatest importance that a good circulation be secured to the nerve centers in the medulla and brain. This can be done by stimulating the superior cervical ganglion. The vasomotors to the general body should be stimulated so as to equalize the general circulation. The heart itself, if weak, will require stimulation. This can be successfully done by manipulation in the upper dorsal and upper cervical regions. Raising the ribs—especially the upper ribs on the left side—will be of service.

**Prevention of Shock.**—Shock may be prevented by protecting the patient, seeing that he is properly covered and the surface of the body not too much exposed. Prolonged operations are sometimes the source of shock, hence it is a great and important factor. Operations should be done rapidly. Do not allow purging of the patient previous to undergoing an operation. In shock, hot, strong, black coffee will be found useful. It is perhaps of advantage before the operation. Where the shock is from pain, relief may be obtained by pressure upon the nerve involved. In case of injury to the eye, or at a point where it is impossible to reach the injured nerve, morphine may be given hypo-

dermically or opium administered per os. However, there are but few instances where such remedies are necessary. Osteopathic methods are sufficient in almost all cases.

### Hemorrhage.

Hemorrhage is frequently spoken of as (1) arterial, (2) venous, (3) capillary, (4) parenchymatous, (5) interstitial, and (6) internal.

By **Arterial Hemorrhage** is meant bleeding from an artery. This can usually be told by the bright red color of the blood and the pulsation or irregularity of the stream, the blood escaping in jets.

In **Venous Hemorrhage** the blood, while flowing rapidly, is a continuous stream and is blue or purplish-red in color.

In **Capillary Hemorrhage** the blood oozes from the tissues and seems to come from all points in the wound and not from any distinct locality. There are conditions, though, in which venous and arterial hemorrhage can not be distinguished. In case of prolonged anesthesia, the blood is generally purplish, or if the blood has flowed some little distance and is directly exposed to the air, it may become oxygenated and very bright red, even though it has come from a vein. Where bleeding takes place from cavernous tissues or tissue spaces, such as occurs in the corpora cavernosa or from the spleen, it is called *parenchymatous hemorrhage*. Where the hemorrhage takes place in the tissues of a limb between the muscles and along the fascia, it is called *interstitial hemorrhage*. This interstitial hemorrhage may be sufficiently severe to cause a large puffy tumor and to so press upon the blood-vessels of a limb as to obstruct the circulation below.

**Internal Hemorrhage** is a condition where there is bleeding into one of the large cavities of the body, as the peritoneal or pleural cavity.

**Symptoms.**—The symptoms of hemorrhage are both local and general. The local effects are the presence of large quantities of blood. When it occurs in the subcutaneous tissues it forms a puffy tumor, or in a cavity of the body an evidence of fluid. The extravasation of blood takes place along the tendon and muscle-sheaths, or underneath planes of fascia, and after a time causes considerable discoloration of the tissues. The general effects of hemorrhage are the following: If the hemorrhage is rapid, death may follow from syncope. If it is not so rapid, the pulse will be found weak, at first rapid and then slow and fluttering. The skin becomes covered with a clammy sweat and it may often have a greenish tinge. The face becomes pale and the lips blanched. The patient will often complain of vertigo and the eyes will have a fixed and glassy stare and the pupils are dilated. In less severe cases one of the first symptoms is defective sight. The patient complains of objects moving in the room and of everything suddenly turning black, or there may be little objects dancing before the eyes (*muscae volitantes*). The hear-

ing will be defective and the patient may complain of tinnitus aurium. The more severe the hemorrhage, the harder the hearing of the patient. Thirst is inordinate and it is not relieved by frequent draughts of water. The patient is restless and sometimes there is muscular tremor. Especially is this true if there is considerable blood lost. Convulsions generally precede death. Vomiting and regurgitation of the contents of the stomach are not uncommon. Where the hemorrhage is severe and rapid, dyspnea is a marked symptom and the patient oftentimes gasps for air and clutches his chest. A loss of one-half the blood of the body is usually fatal. This amount will vary according to the individual. It is said from four to six pounds is fatal. Oftentimes in cases of concealed hemorrhage, the first evidence may be yawning. The patient complains of a close feeling—not sufficient air and of thirst. An examination should at once be made to determine if there is hemorrhage.

#### General Treatment of Primary Hemorrhage.

**Position.**—To prevent syncope and collapse from hemorrhage, it is essential to keep the head low and the centers supplied with blood, hence the affected part should be elevated and the head lowered. In case of uterine hemorrhage, or hemorrhage from the bowels in typhoid fever and in similar conditions, the foot of the bed should be elevated six inches and the pillows taken from under the head of the patient and absolute quiet enjoined.

**Bandaging.**—The limbs should be closely bandaged with hot flannel bandages. This is of the greatest value in that it renders the circulatory system smaller in size until the quantity of the blood may be increased.

#### Increase of Blood to the Medulla and Other Manipulative Measures.

**Manipulation** in case of hemorrhage should not be directed toward increasing the heart's action, since it may cause a greater loss of blood. The blood flow to the nerve centers may be increased by securing dilation of the carotids and vertebrales and their branches. This can be accomplished by stimulating the vasomotors in the neck. Any manipulation should be gentle and not sufficient to disturb the patient.

**Heat** should be applied to the body by means of hot blankets and hot water bottles. This should be kept up to relieve the shock incident to the hemorrhage and to restore the heat which the loss of blood has taken away.

**Hot Saline Enemata** are of the greatest advantage. In some cases intravenous injections of hot saline solutions are used. This is unnecessary if the enemata are used sufficiently early. A quart of normal salt solution should be allowed to run into the bowel and must be retained. If it is voided by the patient, more should be introduced by means of a fountain syringe.

**Diet.**—The subsequent effects of hemorrhage may be best treated by the administration of highly concentrated and digestible foods. Give water, beef broth or beef juice, eggs, milk, and such other nourishment in small quantities, frequently repeated.

#### Methods of Arresting Hemorrhage.

**Nature's Method.**—Nature's method of arresting hemorrhage is to bring about a lowering of the blood pressure. This is accomplished by dilating the blood-vessels in the splanchnic area so that the blood pressure is markedly lowered in the bleeding artery. Then the flow of blood from the artery becomes less rapid. Furthermore, the inner coat of the artery is made up of elastic tissue and when this is torn or injured it has the property of contracting and curling up. As it contracts it more or less obstructs the lumen of the vessel and furnishes numerous points which are favorable to the coagulation of the blood. As the blood flows more slowly and as it is brought in contact with the atmosphere, the lumen of the vessel being reduced, the end of the artery may become plugged by a clot. This clot will form in the vessel extending back to where the first branch is given off. In this way nature endeavors to arrest the hemorrhage. It is not unusual that the hemorrhage may become arrested, and then by means of the contractions of muscles or movements, these clots may become disturbed. With the rise of blood pressure, as the heart becomes stronger, these plugs are forced out of the ends of the arteries and a subsequent hemorrhage occurs. Repeated hemorrhage of this kind may continue until the patient dies, so that it is necessary to enjoin the strictest quietude where the methods are not at hand to stop the hemorrhage and we must rely upon nature's effort. Where hemorrhage takes place into a cavity, such as the pleural cavity, it will continue until the pressure within the cavity is equal to that within the vessels. This, it can be readily seen, would require a considerable amount of blood. There are two chief factors which have to do with the formation of clots within the vessels in the operation of nature's method for the control of the bleeding vessels. They are (1) enfeeblement of the heart and (2) the absorption of the watery fluids from the tissues. These seem to assist the coagulation process. Should the clot remain within the artery, it will most likely undergo reorganization and the artery will become permanently plugged. Coagulation of the blood in the wound and around the sheath of the artery, and its subsequent contraction, prevent the artery from dilating, consequently the clot is not readily dislodged. The internal clot, because of its adherence to the vessel wall, prevents the escape of blood. Leukocytes migrate from the clot. Proliferation of the connective-tissue cells occurs and the clot becomes reorganized. After a short time inflammatory exudates occupy the place of the clot until finally it becomes changed into granulation tissue and then into fibrous tissue, forming a hard, fibrous plug. This description

of the method of arresting hemorrhage applies to injury of small arteries. When an artery is punctured or when the aorta or one of the larger vessels is injured, this process may not take place. The hemorrhage is likely to be fatal. If the artery is divided in its course, the distal end heals in the manner described. The proximal end will heal in this manner, providing the conditions are favorable and the artery is not too large, so that hemorrhage will destroy life.

The methods employed by the older surgeons in the treatment of hemorrhage were in some cases terribly barbarous, as, for instance, in the amputation of a limb, a red-hot knife was used. It was the common practice, until the days of Ambrose Pare, to pour boiling oil over an amputation stump to check the hemorrhage. Sometimes the stump, after amputation, was immersed in boiling pitch, but after nature's method of arresting hemorrhage became better understood, the methods of the surgeons were made to comply with and to imitate it. Nature's method depends upon these conditions:—The fall of the blood pressure, the contraction of the arterioles brought about by the action of the muscular coat, the curling up of the internal coat with the terminal plugging of the vessel, together with the increase of the coagulability of the blood. This increase of the coagulability, as before mentioned, is brought about by the slowing of the blood and the increase of its watery elements and by being brought in contact with the air.

**Surgical Methods.**—(A) Temporary. The temporary methods of controlling hemorrhage are (1) direct pressure on the bleeding artery, which can be at once accomplished by placing the thumb or finger over the bleeding point and holding it, or pressure may be made upon the bleeding point by means of surgical dressings and a suitably applied bandage. (2) Pressure between the bleeding point and the heart, which may be accomplished in the following ways:—digital pressure, forced flexion, and the tourniquet. The femoral artery may be compressed where it passes underneath Poupart's ligament. The dorsalis pedis artery may be compressed on top of the foot. The popliteal artery may be compressed by forced flexion. The posterior tibial artery may be compressed above the internal malleolus. In severe hemorrhage from the palmar arch, the brachial artery may be compressed at the insertion of the coraco-brachialis muscle. The axillary artery may be compressed by pressing it against the head of the humerus. The subclavian artery may be compressed where it comes over the first rib. The temporal artery may be compressed anywhere upon the side of the face and head. The occipital artery may be compressed as it passes up behind the ear. In this manner hemorrhage can be arrested until other means can be used. Where a limb is torn and mangled and there are numerous arteries injured, a tourniquet may be necessary. This can be applied by taking a handkerchief or piece of cloth and tying it loosely around the limb, then inserting a stick and twisting it. The knot in the cloth should be placed over the leading vessel. The tourni-

quet may be twisted sufficiently tight to arrest the hemorrhage. It must not be twisted sufficiently tight as to entirely cut off the circulation, or gangrene of the stump will take place, providing the tourniquet is allowed to remain for any length of time. Even a few hours may be fatal to the tissue beyond the point of compression. Morton's elastic bandage or an elastic tourniquet is often very valuable where it is at hand.

(B) Permanent methods. The permanent surgical methods of controlling hemorrhage are the following:—(1) Cold, (2) Heat, (3) Pressure, (4) Ligature, (5) Torsion, (6) Acupressure, (7) Forcipressure, (8) Cautery, and (9) Styptics.

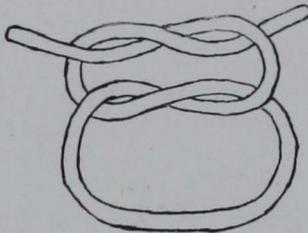
**Cold** may be applied in the form of a cold water coil or ice-pack, preferably in the form of ice. It seems to cause the muscular coat of the artery to contract and drives the blood out of the part. Severe cold favors coagulation of the blood in the smaller vessels. Ice-pack to the right iliac fossa is of advantage in hemorrhage in typhoid fever. Ice applied directly to the bleeding surface is of benefit.

**Heat.**—In the control of venous and capillary hemorrhage, heat is the most valuable agent, next to ligature, that we have. Water should be used as hot as can be borne. The water should be at least 120 degrees F. and in many instances water of greater heat is of great advantage. The best method of application is by sponges wrung from hot water and applied to the bleeding surface. This causes the contraction of the arterioles and coagulation of the blood in the mouths of the vessels. By rapid and constant changing of the sponges, together with the local pressure, hemorrhage may be quickly staunched. The success of the method depends upon its rigid application.

**Pressure** has been mentioned as one of the temporary methods of controlling hemorrhage. It likewise can be considered as one of the permanent methods. In injuries where the arteries may be compressed between the dressing and bone, as in wounds of the temporal or occipital artery, a mass of gauze and cotton may be placed over the artery and a tight bandage placed about the head. Here pressure is made directly upon the artery by the bandage which is sufficient to control the hemorrhage and yet will not interfere with the nutrition of the tissues and the healing of the wound. Pressure can be applied in a similar manner, by a tight bandage, to stumps. Care should be used in the application of the bandage, not to interfere with the return circulation. In hemorrhage from a varicose ulcer or injury to an artery or vein of the lower leg, the part may be bandaged snugly from below up. The bandage may be allowed to remain until nature completes the work by causing coagulation in the mouths of the vessels, thereby arresting the hemorrhage. In case of hemorrhage from the uterus, tamponing the vagina is a valuable method. In hemorrhage from the nose, tamponing the posterior and anterior nares is of the utmost value and many times will save life when all other efforts are futile. The posterior nares

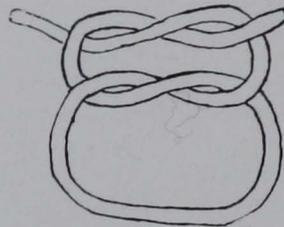
may be best tamponed in the following manner:—Take a small rubber catheter and tie to it a string several feet in length. The catheter may then be pushed back through the nose until it enters the pharynx, where it may be grasped with forceps and pulled through the mouth. We now have a string coming out of the mouth and nose. A pledget of cotton of sufficient size, which when compressed will be about as large as the patient's thumb, should be used. This is tied to the string coming out of the mouth, when by means of the string coming out of the anterior nares, the cotton may be pulled back up into the posterior nares. This will successfully cut off the hemorrhage in that direction. The anterior nares may be readily plugged by inserting cotton. The plug in the posterior nares may be allowed to remain thirty-six hours or longer, or until the physician is sure that the mouths of the vessels have been closed by nature. An instrument may then be pushed in through the nares and the plug pushed out in the pharynx and removed.

FIG. 18.



A reef knot, the kind used in the ligation of an artery.

FIG. 19.



A granny knot, the kind not to use in ligaturing a vessel.

**Ligature** is the most reliable of all the methods of permanently arresting hemorrhage and it is one which is frequently used. Material used for the ligature are chromicized and asepticized catgut, sterilized silk, and kangaroo-tendon. Of these ligatures, silk is most generally used because it is more readily rendered aseptic. Before asepsis and antisepsis were thoroughly understood, it was customary in ligation of an artery to allow the ends of the ligatures to hang out of the wound. Each day as the surgeon visited his patient he would pull the ligature slightly until finally the end of the artery was pulled off and the ligature pulled out. The wound was then allowed to heal by second intention. It has now been shown by experience that silk, if aseptic, under reasonably favorable circumstances, will remain as an inert body within the tissues and will not occasion any mischief, but will become encapsulated; perhaps partly absorbed. Kangaroo-tendon and chromicized catgut have the advantage that they will after a while become absorbed, but they have the disadvantage that they can not be so successfully sterilized as silk. In the application of a ligature it should be tied sufficiently tight to prevent its slipping, and none of the tissues surrounding the artery should be enclosed with it. The artery should be tied by

means of a reef knot or a friction knot. When the ligature is applied, the internal coat is broken, the end retracts and curls up and becomes crumpled, coagulation of the blood readily takes place and secondary changes, organization of the clot and encapsulation of the ligature, follow in sequence.

**Torsion** consists in seizing the end of a bleeding artery with an artery forceps, drawing it from its sheath and twisting it several times until it is felt to partly yield. Four or five complete turns will be sufficient. Where the artery is large it should be pulled out a half inch and grasped by one artery forceps, while another grasps the end of the artery. The one forceps holds the artery firm, while with the second forceps, or the one grasping the end of the artery, torsion is made. This method of arresting hemorrhage is applicable to arteries the size of the radials, brachials, and even the superficial femoral. In this method no foreign body is left in the wound, hence there is less danger in the wound healing, likewise less danger of scar. This method can not be used if the artery is diseased. It is said that in some cases necrosis of the artery has taken place. This method was employed even by ancient surgeons. In small arteries or where suppuration would be especially disastrous, this method is valuable.

**Acupressure** is controlling hemorrhage by means of pins. It was devised by J. Y. Simpson. The pin passes underneath the vessel, leaving as little tissue on either side and between the pin and the vessel as possible. Silk is then twisted in a figure-of-8 over the ends of the needle. There are other means of applying acupressure needles, but they need not be mentioned, as they are obsolete.

**Forcippressure** consists simply of using a hemostatic forceps to grasp the end of the artery. It is the means used during an operation to control hemorrhage and in many cases will be permanent. It is occasionally used to arrest hemorrhage where the artery is deep and it is impractical to further operate, or where the artery can not be ligated. Apply the forceps and allow them to remain for twenty-four hours, when they can be quietly removed, the patient being kept very quiet and the wound afterwards closely watched. By this time nature has formed a clot within the artery and the subsequent changes, as occur in nature's method of arresting hemorrhage, will take place.

**Cautery** arrests hemorrhage by the coagulation of the blood and partly by charring the tissues, which form an eschar, preventing further flow from the vessels. It is best applied by means of the Paquelin cautery or the Galvano-cautery. The wound or bleeding surface is dried by the application of surgeon's lint or cotton, and the cautery, which is at a full red heat, should be immediately applied. Where these cauteries are not at hand a cautery iron which is heated in the fire may be used. The chief objection to the use of the cautery is that the charred tissues will separate and subsequent hemorrhage

result. It is useful to arrest hemorrhage in the nasal mucous membranes or the tonsils or in some location which is not readily accessible.

**Styptics** should never be used to arrest hemorrhage until all other methods have been exhausted. Personally the writer considers them of little value. The drugs produce coagulation of the blood in the mouths of the bleeding vessels. The agents most frequently used are the tincture of the chloride of iron, in fairly strong solutions, one-half to one dram to an ounce of water; tannic or gallic acid, either in a dry powder or a strong solution. Sloughing of the tissues is often brought about by the application of these styptics and they should be used with the utmost care.

#### Recurrent or Reactionary Hemorrhage.

Recurrent or reactionary hemorrhage occurs because of the slipping of a ligature or because the clot has been washed out of the mouth of the vessel. It calls for immediate treatment, some permanent means being used and the wound redressed. The blood soaked dressings must be removed or infection will take place. Where there is oozing from a stump, it is hardly reactionary hemorrhage. The part should be redressed and perhaps more firmly bandaged.

#### Secondary Hemorrhage.

Secondary hemorrhage is that which occurs after twenty-four or thirty-six hours and which is generally the result of defective formation of the clot within the vessel, or perhaps the result of faulty surgical means. In some cases it may be because of disease of the vessel wall. Infection may lead to ulceration; this, extending into the blood-vessels, may bring about secondary hemorrhage.

**Cause.**—The causes of secondary hemorrhage may be summarized as follows: (1) Bad treatment. This bad treatment may consist of failure to maintain cleanliness and asepsis or ligature improperly applied.

(2) Infection. When infection follows, necrosis of the end of the bleeding vessels may occur. The application of modern methods will prevent infection and secondary hemorrhage.

(3) Disease of the vessel wall. Thrombosis and degeneration of the vessel walls may be such that the ligature will not hold or the artery will break, secondary hemorrhage occurring.

(4) Certain constitutional conditions, as in hemorrhagic diathesis, and in conditions where the patient has a tendency to bleed.

## Treatment of Wounds.

The treatment of wounds may be conveniently grouped under the following heads:—

- |   |  |
|---|--|
| 1. Arrest of hemorrhage, prevention of shock, and relief of pain. | 4. Prevention of sepsis by proper care and the proper dressings rightly applied. |
| 2. Cleansing the wound.   |  |
| 3. Closing the wound and providing proper drainage.               | 5. Attention to the general health.  |

Arrest of hemorrhage, prevention of shock, and relief of pain have been discussed.

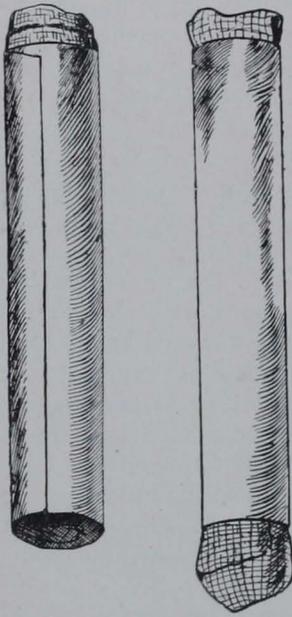
The cleansing of the wound consists in the removal of foreign bodies and irritants of any kind. If the wound has been made by a septic object it is presumed that the wound is septic. If the opening is sufficiently large, as in the case of an incised or lacerated wound, in fact, any wound in which there is an opening sufficient for drainage, the wound should be washed out with an antiseptic solution, either a 1:1000 solution of bichloride of mercury or 1:20 carbolic acid solution. After the wound is thoroughly washed out and cleansed in every part, all foreign bodies removed, such as splinters, bullets, dirt, pieces of glass, etc., provisions may be made to establish drainage and to close the wound. In some wounds where it is believed that the wound tract is not very septic and the opening is small, as happens in a gunshot wound or punctured wound, the surface of the wound only should be cleansed and hemorrhage should be encouraged by compression and all the blood expressed out of the wound, if possible. After washing the surface with an antiseptic solution the wound should be dressed antiseptically by means of cotton and gauze properly applied. It is the best policy not to introduce fluids into these wounds unless in the judgment of the physician they are distinctly septic. It is a well known fact that the tissues of the body may take care of a considerable quantity of septic material under favorable circumstances so that it is well enough to temporize with these wounds and permit nature to handle the case. If evidences of undue inflammation arise, the tract of the wound may be laid open, disinfected, and drained, and allowed to heal from the bottom up by granulation.

The establishing of drainage is perhaps, next to asepsis, the most important factor in the treatment of wounds. Where the wound is large and there is liable to be much exudation, it is of the utmost importance to establish drainage. Drainage should always be established at the most dependent part of the wound. If the wound is on the head and the person will be lying down during the time the wound is healing, the drainage should be at the most dependent point, but if the patient will be in an erect posture most of the time, drainage would perhaps be best established at some other point. At all events it should be so arranged that it will take place in the easiest manner possible.

The materials used for drainage may be strips of antiseptic gauze.

which are laid in the bottom of the wound, or a fenestrated rubber tube, which has been previously sterilized, may be introduced. If the wound is large, the drainage tube should be transfixed with a safety pin to prevent it from dropping into the wound beyond reach. The rubber tube furnishes an additional advantage in that, if the wound is septic, it affords a means of irrigating the interior of the wound with antiseptic solutions. In operations upon the abdomen a cigarette drain is best. The drainage tube or other material should be covered over with a good sized mass of surgeon's cotton to prevent infection and to absorb the wound secretions. In ordinary wounds, especially small wounds, gauze

FIG. 20.



Cigarette drains.

drainage is, perhaps, best. The chief object of drainage is to permit the free escape of serum and other materials which may exude into the wound and which, being retained, would furnish a good pabulum for the growth and development of micro-organisms. Furthermore, the exudation of the serum into the wound prevents union and renders sepsis more likely, inasmuch as it causes great tension of the flaps and interferes with the circulation in the tissues.

**Closure of Wounds.**—The surfaces of the divided tissues must be accurately coaptated, or brought together, and permanently held in that position until the tissues have had time to establish firm union. Where the wound involves different layers of tissues, as fascia, skin, muscle, nerve, etc., if a good result is obtained the nerves should be brought in apposition, also muscle to muscle, fascia to fascia, skin to skin, so that, when union takes place, the tissues are in as nearly a

normal position as is possible for them to be. There are numerous methods of wound closure. The method which is of the greatest value and most universally used, and in fact is absolutely necessary, is by some kind of a suture. The materials used for sutures are silver wire, silk, horse-hair, silkworm-gut, catgut, and kangaroo tendon. The qualities, which these different forms of sutures possess, vary. An ideal suture should be one which is, first of all, aseptic, secondly, that it must be of sufficient strength to hold the tissues in position, and thirdly, that it is not absorbent, that is, that it will not absorb the fluids from the tissues nor from the surface of the body. Silver wire has this advantage, that it is very easily sterilized, is non-irritating and is not absorbent, but on the other hand, it is not so easily applied and, after union takes place, it is more difficult to remove. It causes pain and irritation upon

removal. Silkworm-gut is, in many respects, the ideal suture and is suitable for closing the abdomen or for use in perineal operations or in very large wounds, but it is not absorbable and of course must be removed. It is an animal suture and is best sterilized by boiling for at least an hour, when afterwards it may be kept in strong alcohol until used. Sometimes it becomes more or less brittle and breaks easily. This is one objection to its use. But as a superficial suture, in many respects, it is superior to any other form. In superficial sutures, horse-hair is not irritating, is readily removed, and being fine, is of advantage where a small suture is demanded. It is suitable for superficial suture in closing wounds on the face. Silk suture is the most universally used. It can be readily sterilized by boiling or by the use of antiseptics. Its chief objection is that it is absorbent and when used on the surface, a stitch-abscess may result. But with all its defects, silk is a most excellent suture material. It was formerly believed that silk could not be used in the tissues where it was allowed to remain, but it has been shown that if it is sterile it will not act as an irritant, but will become encapsulated and be harmless. Silk may be sterilized by boiling, or by immersing in a superheated strong solution of mercuric chloride, or 1:20 solution of carbolic acid. The carbolic solution may be heated to boiling, and when the suture material is immersed in it, in a short time it will become sterile. After the sutures are sterilized, they should be kept in an air-tight, thoroughly sterile jar or container made for the purpose. *Catgut* has the advantage over the sutures before mentioned in that it is absorbable, being liquefied by the fluids from the tissues. The suture is made from the submucosa of the intestine of the sheep. The method by which it is made is as follows: The mucous membrane is first rubbed or scraped off, and then the muscular coat is scraped off until only a thin submucosa is left. This is cut into strips and rolled and dried. Afterwards it is rendered aseptic by various methods, boiling in cumol or by heating to a certain degree at stated intervals, for several days, or a week or more. Several of these methods are now known to be reliable and catgut can be obtained which is aseptic; but with all that, it is not a suitable superficial suture. Healing of the wound will not take place readily, since, when the suture becomes liquefied, it furnishes a pabulum upon which the bacteria will develop, and infection at the stitch-holes is common; in fact, it may lead to general infection of the wound. It is useful as a buried suture where the wound is closed and subsequent removal of the suture would be impossible without a secondary operation. It is put up in several forms, carbolated, chromicized, etc. Chromicized gut is rendered harder by the action of the chromic acid and therefore becomes liquefied much less rapidly, remaining in the tissues for a long time. Chromicized gut is used for the ligation of arteries. It will generally become liquefied within ten days or two weeks. Three or four days is sufficient for the liquefaction of the ordinary catgut. Kangaroo tendon is used to a considerable extent for subcutaneous sutures; it is not used on the

surface. It has the advantage that it is readily absorbed and is not irritating. The methods by which these sutures can be sterilized are various and are only successful when they are thoroughly carried out. Reliable suture material can be obtained from certain supply houses. Unless the surgeon is equipped to do his own sterilizing thoroughly and successfully, it is better to get the sterilized sutures already prepared.

According to the manner of their application, sutures may be classified into buried and superficial. By buried suture is meant a suture which has been placed in the tissues for the purpose of coaptating some of the deeper structures and which is allowed to remain in situ and not afterwards removed. Superficial sutures may be readily removed at any time. Of the method of application, the following are some of the varieties in use:

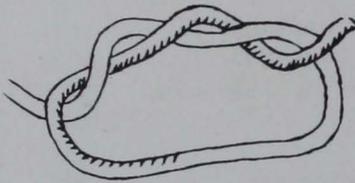


FIG. 21.

Friction knot, the kind used in tying sutures.

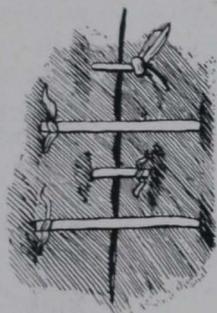
1. Superficial or coaptation.
2. Deep or relaxation.
3. Interrupted.
4. Continuous.
5. Quilled.
6. Figure-of-8.
7. Halsted's.
8. Lembert's.
9. Button.

The needles in use for the application of these sutures should have a sharp point and may be either curved or straight. There are two

needles which are in most general use. These are Peaslee's and Hagedorn's. The Hagedorn needle has the advantage that the slight cut made by the needle entering the tissues is parallel with the direction of the suture or is transverse to the wound, whereas the cut made by the Peaslee needle is parallel with the wound. In tying a suture introduced by a Peaslee's needle, the little cut made by the needle is pulled open. Troublesome hemorrhage has followed such application of suture. This is not true of the Hagedorn needle, as the thread pulls in the end of the cut, and the more tightly the suture is drawn the more closely do the cut surfaces of the needle-hole press against each other and thus hemorrhage is avoided. The needle, having been previously sterilized, is threaded with the kind of suture material best suited for the occasion in question and should be introduced, wherever possible, with the fingers. Numerous needle holders have been invented by mechanics and by operative surgeons, but no needle holder is so good as deft fingers. Then, too, the best needle holder is liable to break. Where the needle is small and where the surgeon is operating in a cavity, it may be necessary to use a needle holder. A suitable automatic one should be at hand. Unless a surgeon has a number of assistants, the needle holder may entail useless delay. In the closing of an ordinary wound, the suture should be introduced down to the bottom of the wound, so that when

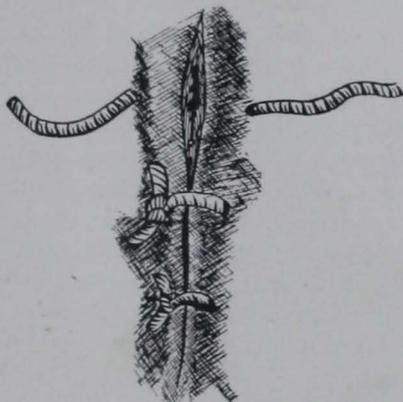
it is drawn up snugly and tied, all parts of the wound-margins are brought in apposition. If this is not done, serum will exude into the lower part of the wound. A cavity is thus formed, filled with serum, which furnishes an excellent nidus for the development of bacteria.

FIG. 22.



Coaptation and relaxation sutures.

FIG. 23.



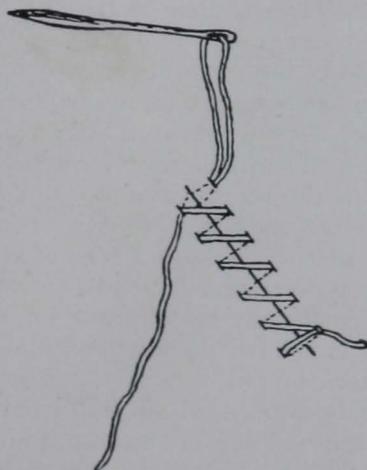
Interrupted suture.

Suppuration is almost sure to occur unless the wound is closed in all its parts.

The method of application may be an interrupted or continuous suture. The interrupted suture is the one most frequently used and has the advantage that it can be applied evenly. A moderate amount of swelling will not interfere seriously with the suture. A continuous suture will not so readily accommodate itself to other conditions than those present at its introduction. It is not so easily removed. It is useful for closing large wounds quickly where the wounds are upon the surface, or it is suitable for use in buried suture in apposing fascia.

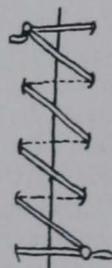
Halsted's continuous subcuticular suture is an excellent superficial suture of silk, which need not be removed.

FIG. 24.



Method of ending a continuous suture.

FIG. 25.

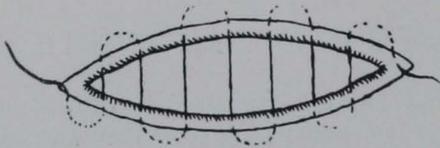


A continuous suture applied.

By deep or relaxation sutures are meant sutures which are introduced a distance back from the edge of the wound, including all the deep tissues, and are for the purpose of lessening the tension upon the

sutures which are at the margins of the wound. Coaptation sutures are those which are put in at the margin of the wound and are for the purpose of accurately apposing the surfaces. The quilled suture is no longer used. The figure-of-8 suture is still popular in plastic surgery, especially in harelip. It is applied by the insertion of silver harelip pins (an ordinary commercial iron pin may be used). The pins are first sterilized and then inserted, and a sterilized thread is placed in a figure-of-8 manner over the ends of the needle. It has the advantage that there is but little scarring of the skin and it holds the superficial tissues in position. Halsted's suture is a valuable suture under some circumstances. By the use of this suture, the scars, the result of the wounds made by the needle, are avoided. The button or shot suture is still sometimes used. Lembert's suture is useful in suturing wounds in the small intestines or any of the hollow viscera. Other forms, such as the mattress suture or Ford suture, may be used if the occasion demands, but these occasions are few, if they ever arise. In the use of needles and suture material for the closure of wounds, it is the best policy to use as small a needle as possible, the finest silk for coaptation

FIG. 26.



Halsted's sub-cuticular suture.

sutures, and for retention sutures, the larger silk. The twisted silk is the stronger. In tying sutures the knot should not be drawn too tightly. If the suture is drawn tightly it will more or less arrest the circulation to the tissues underneath it and sloughing of the

skin, or stitch abscess may follow. If the suture is aseptic, it will not operate as an irritant unless it interferes with the physiological process of repair. There are a few other means of wound closure which should be understood, and which are useful in small wounds where other methods are not available. These consist of adhesive plaster, collodion, etc., which have the property of adhering closely to the skin, and if the wound is small, holding the edges in apposition. Tear the adhesive plaster in very small strips, dry the surfaces of the wound, heat the adhesive plaster and as the tissues are held together, the adhesive plaster is applied. Collodion may be used in a similar manner. Little strips of iodoform or borated gauze may be laid over the wound, which has been dried, and the whole painted thoroughly with collodion. Another fairly successful method of closing a wound, where sutures are not at hand, is to stick firmly to the skin strips of adhesive plaster which extend parallel with, and not too far distant from the wound. Then by means of a needle and ordinary thread, apposition can be secured by bringing the thread through the strips of adhesive plaster and then tying it. This will be found successful in small wounds or where suture material is not at hand. After a suture is applied, if the tension becomes so great on the flaps that there is

indication of the suture cutting the tissues, some of the sutures should be removed.

To remove a suture successfully, it must be done in the following manner: The part of the suture which is without the tissues is more than likely septic, so in removal the suture should be cut off below the skin. While the suture is lifted up with a dressing forceps, the tissues may be pressed down so that a margin of a quarter of an inch of the suture, which was formerly within the tissues, may be pulled out and the suture can be cut off at this point. This will prevent stitch-abscesses. The length of time sutures are allowed to remain in the tissues will vary according to the nature of the wound and the nature of the tissues. In the face, coaptation sutures should not be allowed to remain longer than thirty-six to forty-eight hours. A retention suture should be allowed to remain longer, until there is no danger of the wound being pulled apart. In case of lacerated perineum, the suture should be allowed to remain ten to fourteen days, providing evidences of inflammation do not appear, for the reason that the motions of the body and the evacuation of the bowels may cause the newly united structures to separate. Ordinarily in a vascular area like the hand, the suture may be removed on the third, fourth, or fifth day. In an area, as over the back, or on the thigh, union will not take place as quickly and the suture should be removed on the sixth or seventh day.

**Prevention of Sepsis.**—Providing the wound has been thoroughly cleansed, no drainage being necessary, the wound is coaptated and lastly washed thoroughly to get rid of all materials which might remain. The wound may be dressed with or without antiseptics. The object of the dressings is to prevent sepsis and protect the wound. Dressings then should be sterilized and should be of a material which will readily soak up any wound-secretion or discharge. An antiseptic or aseptic gauze is found to be the most serviceable. Outside of these gauzes may be placed a considerable amount of aseptic cotton. The cotton prevents any micro-organisms getting into the wound and will, at the same time, absorb any of the secretions which are discharged.

**Removal of Dressings.**—Providing there is but little discharge, the dressings should not be disturbed until it is necessary to remove the sutures. If drainage has been established, the dressings should be looked into within the first twenty-four hours, or sooner. Under no circumstances should the dressing be allowed to become saturated. Should this happen, infection quickly travels into the wound from the outside. The drainage tube should be removed in from twenty-four to thirty-six hours, for the reason, if it remains there too long, it will act as an irritant and cause inflammation in the tissues round about and prevent the wound healing. The idea which the surgeon should have in mind is that the wound should not, under any circumstances, be disturbed unless he feels that it is not doing well, or that it requires change of dressing because of its having been disturbed or because of an excess of

secretions. The wound should be properly dressed in a manner according with the principles of modern surgery, and when once dressed should be allowed to remain quiet until conditions have arisen which demand intervention. If there is evidence of sepsis upon removal of the dressing, an antiseptic solution may be thoroughly used. Under *clean* conditions, considering that the surface has been thoroughly irrigated with an antiseptic solution, several thicknesses of sterilized gauze may be applied to the surface. On top of this is placed a considerable mass of absorbent cotton. If conditions are not very clean, the surgeon may apply boracic acid, iodoform, equal parts of boric acid and acetanilid, salicylic acid, aristol, protonuclein, etc., in fact, any antiseptic drug which prevents fermentation. The gauze may be carbolated five per cent., boracic acid ten per cent., iodoform ten per cent., bichloride of mercury 1:5000 or 1:1000. Any of these gauzes are excellent. Bichloride of mercury is the strongest antiseptic, but is irritating. The borated gauze secures mild antiseptis and asepsis and is, perhaps, the best of all the gauzes. Where there is abundant discharge from the wound, a dressing quickly becomes saturated and should be renewed sufficiently often to keep the wound dry. It will then heal more rapidly. If the dressings are sodden with secretions of the wound, instead of operating as a protection, they furnish a bed for the micro-organisms in the same manner as a flax-seed poultice.

**Rest.**—Functional and mechanical rest is of the greatest importance in the treatment of wounds. The process of repair is accomplished by the reproduction of new cells. These granulation-tissue cells are very delicate and easily destroyed. Every movement of the injured part will destroy some cells and call upon the tissues for renewed activity to produce others. In fact, if the irritation is great, it may either prevent the wound healing or may cause a considerable formation of fibrous tissues, which is always detrimental in any location in the body. At best, the process of repair is difficult, and the tissues have an added burden in order to properly repair the injury.

**Constitutional Treatment.**—In the healing of wounds, much depends upon judicious constitutional treatment. It is necessary that the bowels act daily, unless there are circumstances which require their quiescence. The urine should be voided at stated intervals. The person should be fed properly and should get the proper amount of sleep and rest. After the shock has been combated and the patient has rallied from the operation or from the wound, he should be placed in the most comfortable position, so that he is as nearly at ease as possible. The room should be sufficiently ventilated, the patient should not be exposed to drafts. In the sick room a temperature of 60 degrees F. is necessary. Many cases will require 70 degrees F. The room should be kept scrupulously clean and especially should the patient's bed be kept clean and his clothing changed daily. The bowels should be kept regular by proper treatment. This treatment will vary accord-

ing to the condition. Sometimes it may be necessary to resort to the use of an enema. In the administration of an enema, a little castile soap diffused in a quart of boiled water should be used. Where the strength of the patient has been markedly reduced, either by shock, injury, or operation, or severe loss of blood, a stimulating diet will be found necessary. Where there is suppuration, it is of the utmost importance that cleanliness be obtained; furthermore, that the patient be given a nourishing diet. The pulse and temperature should be carefully watched, in case of severe wounds, and where there is not a rise of temperature and the patient feels well, it will not be necessary to investigate the wound at the end of the first twenty-four hours, nor may it be necessary even at the end of forty-eight hours. In recovery from old wounds or wounds in the ill-nourished, diabetic, or syphilitic cases, or conditions of tuberculosis and Bright's disease, proper treatment should be administered tending towards the support of the patient and the relief of the existing conditions.

#### Kinds of Open Wounds.

- |               |              |
|---------------|--------------|
| 1. Incised.   | 5. Poisoned. |
| 2. Contused.  | 6. Gunshot.  |
| 3. Lacerated. | 7. Fracture. |
| 4. Punctured. |              |

**Incised Wound.**—An incised wound is one having an evenly divided edge and smooth surface and generally made by a sharp instrument. A wound quite similar to an incised wound may be made with the edge of a hard object, as a brick on the scalp. Often the hemorrhage is very severe in an incised wound, in fact, it is the chief danger. Providing the wound is properly cleansed and good apposition secured, healing takes place by first intention. There is nothing special in the treatment of this form of wound.

**Contused Wound.**—A contused wound is one in which the wound area and edges are severely bruised and injured. It is made by objects which distribute the wounding force over a considerable area. It is usually attended by an extravasation of blood within the tissues. External hemorrhage is slight, the reason being that the mashing of an artery renders the conditions for coagulation of the blood more favorable, hence nature arrests the hemorrhage more quickly. The dangers of this wound are sloughing of the tissues, together with infection. The bruising of the tissues may so devitalize them that it renders infection easy. Under all circumstances, if the skin is not broken, the wound should be handled with the greatest care, so that the skin may not be broken. Any parts of the skin which may have become more or less detached should always be preserved. Contused wounds require more careful measures than incised wounds because of the devitalization of the tissues as the result of the injury.

**Lacerated Wound.**—A lacerated wound is one which is torn. Lacerated wounds are in many respects more harmful than others. Certain of the tissues will be torn and perhaps killed, while others will

have become so devitalized as to be unable to resist the onset of the invading bacteria. Furthermore, lacerated wounds contain many crevices and nooks in which septic material may lodge, so that the probabilities are the wound will not be thoroughly cleansed. Apposition can not be so readily obtained, therefore scar formation is common. The wounds will frequently heal by second intention. The primary hemorrhage is not so great and, as a rule, it should be encouraged. The dangers in lacerated wounds are infection and deformity from scar formation. The edges of the wound should be closed and drainage provided for. Sutures can not be applied as closely as in an incised wound.

**Punctured Wound.**—A punctured wound is one made by a long sharp instrument. The margins of the wound are not contused. The depth of the wound is much greater than its breadth. The chief dangers of these wounds are hemorrhage and infection. Puncture of the viscera or large vessels is liable to be fatal. Suppuration is common in punctured wounds and very often leads to general sepsis. The wound heals on the surface and the infected secretions being retained, pus is formed. Punctured wounds in the body-cavity (thoracic and abdominal) are generally fatal. As a rule these wounds should be caused to unite by second intention. If the wound gives evidence of sepsis, it should be thoroughly cleansed with an antiseptic solution and a piece of gauze introduced to the bottom. Where it is made with a septic instrument, it is advisable to introduce a drainage tube to the bottom of the wound, and each day as the wound is dressed, the drainage tube may be drawn out a half inch or more, until it is finally removed, allowing the wound to heal from the bottom.

**Poisoned Wound.**—A poisoned wound is one in which some poisonous product is introduced. These poisonous products may be classified as bacteria, bacterial toxins, and chemical poisons, such as are present in the bite of snakes, sting of bees, etc. Wounds containing bacteria are called septic and infective. A septic wound should be washed with peroxid of hydrogen, providing the opening from the wound is sufficiently large, and then washed with a solution of bichloride of mercury (1:1000). If infection is arrested, the wound should be kept at rest and the most rigid cleanliness maintained. In post-mortem or dissection wounds we have an example of poisoned wounds. The result will largely depend upon the treatment, the amount of poison introduced, and the condition of the health of the person sustaining the injury. As soon as the wound is infected, it should be washed and treated with suction. Every effort should be made to have the wound bleed freely. Afterward, the wound may be cauterized with pure carbolic acid or strong acetic acid. The hands may then be cleansed with a strong solution of bichloride of mercury. There is, perhaps, the most danger in holding a post-mortem on patients who have died of typhoid fever, septicemia, pyemia, peritonitis, erysipelas, etc. The changes which take place following

infection are, a pustule may be formed and evidences of lymphangitis and phlebitis. Antiseptic lotions should be applied to the wound at once. If the wound is located in the upper extremity, the axillary glands will enlarge and may suppurate. As soon as there is evidence of suppuration these should be removed. Where the infection is rapid and severe, and nature shows an effort at limiting it, an amputation should be performed. The prognosis, in these wounds, is not favorable when one can not prevent general infection. Where severe constitutional symptoms set in, death usually occurs in from ten days to two weeks, or if recovery takes place, it is only after a long, tedious illness. The nature of the inflammation is that of a cellulitis or a condition resembling cellulocutaneous erysipelas. As soon as infection is evident at the wound, incisions may be made in the tissues about, bleeding encouraged, and the wound thoroughly cleansed with a strong corrosive sublimate solution (1:500).

**Snake-Bite.**—The venom of certain reptiles introduces into the circulation, through the wound, substances which may produce alarmingly fatal results. These poisons, in some cases, are extremely rapid in their action, depending upon whether the poison is introduced into the circulation or whether it reaches the circulatory system through the connective tissues and the lymphatics. Snake-bite may be likened to a hypodermic injection of a chemical poison. The poison acts directly upon the muscular and connective tissues, and when it enters into the circulation, it affects the nervous tissues generally. Many of the reptiles reputed to be poisonous, have no special poison. On the other hand, bites of animals, such as rats, or even the bite of a person, may at times be poisonous, depending upon the materials carried into the tissues by the teeth. The poisonous snakes in this country are the rattlesnake (of which there are perhaps eighteen different species), the water moccasin, copperhead, and, perhaps, the viper, although the ordinary spreading viper or puffing adder is believed to be harmless. There are also said to be some poisonous lizards. The exact nature of the poison is not definitely known. It seems to be a collection of compounds containing peptones, globulins, and, perhaps, toxic alkaloids, which act like ferments, inducing wide-spread chemical reactions. The effect of the poison upon the body varies according to the dose and according to the animal from which the poison was extracted. The poisons of the various reptiles differ not only in their chemistry, but in their toxicity. The poison in almost all seems to have a paralyzing effect upon the wall of the artery, while it brings about disorganization of the blood. Most of the poisons apparently have an affinity for the nervous tissues, uniformly bringing about paralytic changes. The poison of the serpent is introduced by means of a hollow fang, and is produced by a special gland. The duct of the gland leads to the hollow tooth, and in the working of the jaws, the poison is compressed out of the gland through the hollow tooth, and in this manner introduced into

the tissues. If the poison-bag and the fangs are removed, the snake will be harmless.

The **Symptoms** of poisoning are as follows: The pain is excruciating, coming on very rapidly after the bite. The part of the limb swells rapidly and becomes mottled because of the effect of the poison upon the blood. It is not unusual that the swelling of the member is enormous. Consciousness is more or less affected. This varies in degree from slight lethargy and stupor, to complete unconsciousness. The symptoms are those of profound shock, which may be attended with delirium. Death may come on within an hour or it may be delayed several hours. Where death does not occur during the first twenty-four to forty-eight hours, gangrene and sepsis frequently arise.

The **Treatment** for snake-bite is to at once tie a tight band about the member, above the wound. Several of these bands should be placed around so as to restrict the return circulation. The wound should be treated with suction, either by the person himself, when possible, or by some friend or relative who is not afraid to take the risk. Care should be taken that the person performing this suction has no wounds on the lips or mouth, as they likewise may become poisoned. A crucial incision should be made at the bite and hemorrhage encouraged. As soon as the wound is thoroughly sucked, it should be cauterized. Hunters frequently cover the bite with powder, which, upon being ignited, chars the skin. A hot iron may be used for a cautery or pure carbolic acid may be applied. A strong solution of permanganate of potassium is excellent, inasmuch as it seems to have the property of destroying the poison. A two per cent. solution is sometimes injected into the tissues about the wound. The wound and member should be kept soaked in alcohol. It is said to be more efficient if the alcohol contains one-third of camphor. Where a surgeon is at hand, amputation of the member is advised if the bite of the reptile is very poisonous. Strong ammonia-water applied to the wound seems to be an excellent method of destroying the poisons.

**Bites and Stings of Insects and Certain Animals.**—There are certain lizards whose bites are said to be poisonous. These bites should be treated in the same manner as a snake-bite. The bites of certain spiders are productive of severe inflammation, great prostration, and, in some cases, death. These spider-bites should be treated similarly to snake-bites. As soon as the bite is made, suction should at once be applied. If this can not be done, enlarge the wound and encourage bleeding. Tie a fillet around the member, if it is possible, and cauterize the wound with strong carbolic acid or strong ammonia and use alcohol as a local application. The bite of the centipede is not so fatal as is popularly believed. The effects are, generally, only local. The bite of the scorpion produces much severer symptoms. Very often there is great prostration, vomiting, delirium, with local swelling rapidly extending, and severe burning pain. There may be vertigo or severe head-

ache, together with great sweating and diarrhea. Bee-stings, if multiple, may cause severe symptoms or even death. A bee-sting is in the nature of a poisoned wound, being made by two little lancets which are pushed out and the poison is squeezed in between them and then inserted into the wound. When the wound is over the cellular tissues of the body, swelling is sometimes very rapid and great. Sometimes the pain is extremely excruciating. Where there are several stings, constitutional symptoms, such as delirium, vomiting, diarrhea, and considerable shock, may be manifest. Where death follows these severe symptoms, it is usually from heart failure. Stings in the mouth may, without causing these symptoms, bring about edema of the glottis which may be fatal. Such stings should be looked upon with fear.

**Treatment.**—Wash the part with a strong solution of soda or salt and apply ammonia-water. Ice applied is very grateful, as it lessens the inflammation.

**Gunshot Wound.**—A gunshot wound is peculiar, in that the opening is very often small, surrounded by a contused area, and the tract of the bullet very often long, giving an example of a deep wound with a small opening. Drainage is difficult to obtain. The wounds arising in military and civil practice vary greatly, inasmuch as projectiles vary and are discharged in one case with much more force than in the other. Bullets may sometimes cause fracture of a long bone or they may cut off a nerve to a part or may button-hole a large artery. They very often glance around these structures unless hurled with terrific force.

**Injury to the Soft Parts.**—The course of the bullet in the tissues varies according to the velocity and nature of the bullet. The bullets may be deflected by fascia, bones, and ligaments. If the skin be struck at the proper angle, and the bullet be "spent", it will be only grazed, or merely a streak left. The opening made by the bullet is very often, unless fired at close range, accompanied by laceration of the soft parts. The exit of the ball is in some cases marked by much more extensive laceration than in the entrance. Especially is this true of the soft-nosed bullets. There the core projects out and forms a mushroom-like mass and is terrifically destructive. Ordinary pistol-balls are not nearly so destructive. They may bury themselves in the ends of the long bones, but rarely pass entirely through the bone, while the injury to the bone is generally not so great. In civil practice the injury to the joints is usually not very extensive. The chief element of danger seems to be sepsis. The results of gunshot wounds may be summarized as (1) hemorrhage. Hemorrhage may be very severe, but it is usually speedily arrested by natural processes. Gunshot wounds, even of the internal jugular, may not prove fatal. Especially is this true if there is contusion. The contusion causes the middle and inner coats to curl up and plug the ends of the arteries and veins. Secondary hemorrhage is not uncommon, and is usually due to sepsis. Where the wound is aseptic, secondary hemorrhage is not likely to occur.

(2) Pain. The pain is variable, depending upon whether a large nerve is injured. In case the injury is within the explosive action of the ball, the part may be anesthetized more or less because of the contusion. It may be that the anesthesia due to the contusion is great and, if occurring during mental excitement, a person may not know that he is struck. In such cases infection is more likely. Where fracture is caused by the bullet, the pain is very often excruciating. Shock attending bullet injuries varies greatly. A small wound of the extremity, although trivial in nature, may be accompanied by general shock. Perhaps the effect is largely due to mental emotion. On the other hand, penetrating wounds of the abdomen in many cases occasion but comparatively little disturbance. Often pistol wounds of the brain may cause less disturbance than would be expected.

**Treatment.**—In civil practice, the treatment of gunshot wounds will differ from that of military practice. Where the patient can have the advantage of a hospital and of a clean operating room, in fact, where asepsis can be secured, it may be the best policy to uniformly investigate these wounds; but it must be kept in mind that the presence of the bullet and the little material which the bullet may have carried into the wound, are in no wise as serious a menace as will be the septic materials introduced by unclean hands and instruments, in the effort to locate the ball. Too many physicians, in treating the bullet wound, seem to feel that they must get the bullet regardless of the effect of their operations or methods upon the life of the individual. Miscellaneous probing of bullet wounds is extremely bad. Of all the objects introduced into the wound, a clean finger is the least harmful. Where the wound is too small to permit of the introduction of the finger, and none of the large cavities of the body has been entered or viscera perforated, the best treatment seems to be to cleanse the surface thoroughly by means of antiseptic solutions, encourage bleeding and dress the wound with antiseptic dressings and await developments. If the bullet causes subsequent trouble it may be removed by operation. The truth of the maxim, that "when a bullet has ceased to move it has ceased to do harm," has but few exceptions. These are perhaps where the bullet may ulcerate into a large cavity, or when present in the brain, by gravity may cause pressure symptoms, but generally when located within the tissues, unless especially septic, it will not occasion any very considerable trouble. The probe used to investigate the wound should be metal and as large as can be conveniently introduced into the wound. It should be blunt-pointed so as not to injure the tissues in any way. Nelaton's porcelain-pointed probe is valuable in some cases in locating a bullet, inasmuch as the lead will leave a mark on the point. Gardner's telephonic probe is, perhaps, the best of the various electrical devices, but its virtues are questionable. Where the bullet is superficial it should be removed, but if deep and not readily reached and it is believed to be in a part of the body where it will not occasion much

harm, the surface of the body should be cleansed and the wound treated in an antiseptic manner and allowed to heal of itself. If it is believed that a patch of the clothing is carried in with the bullet, an effort should be made to remove such material. Where it is possible to use it, the x-rays should be utilized in locating the bullet. A bullet forceps may be used in the extraction of the bullet, or the wound may be enlarged, when it may be seized with forceps or a scoop, or a Volkman spoon may be of advantage.

**Other Foreign Bodies in Wounds.**—Bits of glass, needles, and other objects may be blown, hurled or driven into the tissues and their presence occasion great harm. Glass can be located by the x-ray, as can most of the other objects. Universally these foreign bodies should be removed. A needle is perhaps the worst of these penetrating foreign bodies. Especially is this true where the needle enters the palm of the hand or sole of the foot. The needle should be removed at once. Muscular contractions will often cause the needle to follow along the tendon-sheaths or planes of fascia or along through the muscles, so that each contraction drives the needle farther distant. In removing a needle it should first be accurately located and a sufficiently large incision made, so that it can be successfully reached. Under no circumstances should a little wound be made and the tissues separated in an attempt to reach the needle, as the efforts of the surgeon may push the foreign body further in. After the needle is removed, the wound may be given ordinary treatment.

**Contusions.**—Contusions, not attended by an open wound, may, in some cases, cause considerable damage to the soft-parts and may require special attention. Where a contusion is small it is commonly called a bruise. If this bruise breaks blood-vessels beneath the skin, subcutaneous hemorrhage will occur among the tissues, causing the surface to become black, as in the case of a blacked eye. These ecchymoses may be extensive in some cases. Coagulation of the blood will follow and afterwards the coagula will break down as the serum and other elements are removed. The surface changes into a blue-black or purplish or reddish-black color, while later the skin may assume a greenish tinge. This extravasation of blood may sometimes extend, where it occurs at the shoulder, even to the tips of the fingers, following the fascia. Muscular action is responsible for this. In muscle-bruises, very often the extravasation of the blood is quite severe. These extensive contusions are best treated by rest and a suitably applied woolen bandage, and later, manipulation to assist in breaking up the clot and securing absorption of the fluids. Even though a large tumor be formed by the extravasation of blood, on no account should it be opened, for if once opened and air admitted an abscess will result. If allowed to remain, nature will take care of the effused material and the part will finally return to its normal condition.

**Burns and Scalds.**—Burns and scalds are merely wounds from thermal causes, but deserve special mention because of the difference in

the symptoms and treatment. Burns differ from scalds in that they are more destructive. If a burn has been produced by boiling oil or by molten metal, the destruction of the tissues is sometimes very great. The effects of burns are both local and constitutional. These depend sometimes upon the severity of the burn, that is, whether it is attended by extensive destruction of the tissues in any part, or if the burn is slight and extends over a large area. Burns of the trunk are more serious than burns of the extremities. Burns and scalds have been classified by Dupuytren in the following manner:

1. A burn of the first degree consists of an erythema of the surface which is not attended by any destruction of tissues and leaves no scar. This burn is usually not serious unless it affects a large area of the body, when it may be fatal.

2. A burn of the second degree is where the cuticle is raised from the cutis and blisters result. Should the blisters burst and the cuticle be removed, it leaves a red and inflamed true skin. This burn is more painful and more serious. If it affects a considerable part of the body, it may seriously interfere with the functions of the skin. These blisters may become infected and later, ulceration take place.

3. A burn of the third degree is where the cuticle is entirely destroyed and also part of the true skin is affected. Inasmuch as the true skin contains the tips of the nerves and capillary tufts, these are affected. The terminal nerves may be injured or even destroyed, and the congestion and inflammation which follow, occasion severe pain, and sometimes, destruction of the tissues.

4. In burns of the fourth degree the cuticle and true skin are entirely destroyed, with perhaps some little of the subcutaneous tissues.

5. In burns of the fifth degree, muscles, connective tissues, and fascia, together with the skin and subcutaneous tissues, are destroyed.

6. In burns of the sixth degree an entire member is destroyed.

Slight burns involving a limited area, and which do not extend beyond the skin, while they occasion considerable pain, are not serious. They may be immersed in cold water, which will relieve the nervous chill or rigors and the excruciating pain, or some oil, as sweet oil, may be applied so as to protect the surface from the air. Where these burns, simply of the surface, affect a large area, the shock to the nervous system may be so great as to bring about collapse and death. In burns of the first degree, where only the cuticle is involved, if a fatal result should follow, it will occur within thirty-six hours. Where the effect upon the nervous system is great, it calls for immediate treatment to prevent this fatal termination. Within twenty-four hours the patient enters into the stage of reaction; and subsequent trouble, providing sepsis does not occur, will not be serious unless ulceration should follow in the duodenum, which complication occurs in some burns. This ulceration may extend through the wall of the duodenum into the peritoneum, causing peritonitis. There are other burns of the mucous

membrane, as scalding of the respiratory tract from inhaling steam. In some cases this will set up edema of the glottis and, in other cases, bronchitis or pneumonia. These may be fatal.

The first symptoms of burns of any considerable extent are those of shock. Later there are symptoms of reaction and inflammation, while lastly there are those of sepsis because of infection.

**Treatment of Burns.**—If the burn is extensive, the clothing should be removed with great care. The burned area should be cleansed with a warm, normal salt solution. It may be thoroughly dusted with flour in emergencies. White lead, ready mixed for house painting, has been extensively used. The part may be coated over with the lead mixture. Linseed oil and lime water, equal parts, called carron oil, is more generally used than any other application. Absorbent cotton saturated with this mixture is applied after cleansing the surface. It is a filthy application and results in much pus formation. Surgeon's lint dipped in a two per cent. solution of carbolic acid in olive oil is an excellent preparation.

Where the burn is small, an ointment of benzoated oxid of zinc may be used. Picric acid has a great reputation in burns. It is used in the strength of one per cent. in water. Lint saturated with the solution, is applied with a thick layer of absorbent cotton over it. The dressing is reapplied in three or four days and not again until recovery. Later if there is sloughing and pus formation, the sore must be cleansed daily with a mercurial solution (1:5000) and then dusted with a powder composed of three parts of boric acid to one part of salicylic acid. Healing may be hastened and scar formation lessened by skin grafting. Exuberant granulations will require cauterizing with nitrate of silver. Later the cicatricial contractions must be overcome by manipulation.