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# DISINFECTION AND DISINFECTANTS

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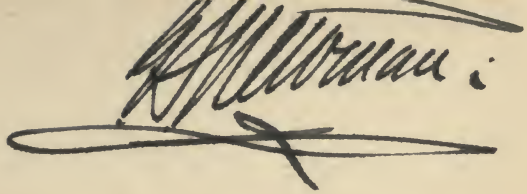



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# Disinfection and Disinfectants.

A TREATISE UPON THE BEST KNOWN DISINFECTANTS, THEIR USE IN THE DESTRUCTION OF DISEASE GERMS, WITH SPECIAL INSTRUCTION FOR THEIR APPLICATION IN THE COMMONLY RECOGNIZED INFECTIOUS AND CONTAGIOUS DISEASES.

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BY

H. M. BRACKEN, M. D.

Professor of Materia Medica and Therapeutics,
University of Minnesota.
Secretary and Executive Officer Minnesota State Board of Health.

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SECOND EDITION.

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# PREFACE.

Progress has been made in the process of disinfection during recent years. We are coming to understand more and more every day the germ theory, or the science of bacteriology, and to appreciate that a great deal of disease is preventable because its cause may be eradicated by the proper use of disinfectants the properties of which are fully understood.

So far as the publishers are aware, however, there is at this time no concise work treating of the modern methods of disinfection which have been brought into very common usage since the introduction of formaldehyde in its various forms. To meet this want the little book which follows was suggested and the author, who had enjoyed ample opportunity for practical tests and wide observation and study of the best methods employed, was selected to prepare this volume. How well he has done his work the reader is left to judge. It may be added that in its compilation he has been guided by a desire to give all who may be called upon to do disinfecting under the direction of village and town boards of health, and to the embalmer especially who is more and more being called upon to perform this important duty for the living while caring for the dead, a concise, readily understood and at the same time comprehensive and reliable guide.

THE PUBLISHERS.

Chicago, August, 1900.

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## PREFACE TO SECOND EDITION.

The first edition of this little book having been exhausted, the Author takes this opportunity to make such alterations, additions and rearrangement as will bring it up to date. H. M. Bracken.

Minneapolis, August 1st, 1901.

# INDEX OF TOPICS.

# INTRODUCTION.

There is often confusion in the use of the terms deodorizer, antiseptic, disinfectant and germicide.

**A Germicide** is an agent capable of destroying germs or their spores.

**A Disinfectant** has practically the same properties, for it must be capable of the same action, or otherwise the part to which it is applied is not disinfected.

**An Antiseptic** is not necessarily a germicide or disinfectant. It may be much weaker in action. It is an agent sufficiently active to prevent the growth of germs, but not necessarily to destroy them.

**A Deodorizer** or deodorant may be still weaker in action than an antiseptic. It may destroy or mask disagreeable odors without of necessity having any influence upon germs or their spores. Deodorizers are worse than useless in dealing with the infections of disease, for by removing disagreeable odors they often give to the uninitiated a feeling of safety which does not exist, the cause of infection not having been removed.

A germicide or disinfectant is of necessity an antiseptic and may be a deodorizer. An antiseptic is not necessarily a disinfectant; it may be a deodorizer. A deodorizer is not necessarily a disinfectant or an antiseptic, but it may be both.

# Disinfection and Disinfectants.

## CHAPTER I.

### THE USE OF DISINFECTANTS.

*I. Among the Living.*

Disinfectants are used among the living—

(a) To prevent further infection of the diseased individuals.

(b) To protect those who have been exposed to infection;

(c) To prevent the further spread of infection.

The first, (a), is well illustrated in surgery, where the surgeon cleans out and thoroughly disinfects an infected wound and expects the healing process, after such action on his part, to go on as rapidly as though infection of the part had never existed. Had he left such an infected wound uncleaned the local infection might easily have caused general infection, which would end only with the loss of a part, or even of the life, of the patient.

It is also well illustrated in daily life, where evil effects that might naturally follow the prick of a poisoned needle or the scratch or abrasion from other

infected material are combatted by the vigorous use of cleanliness and disinfectants.

The second, (b), is well illustrated in our care of such diseases as typhoid fever, tuberculosis, diphtheria, etc. The nurse of a typhoid fever patient is in little or no danger of infection from this disease, so long as she keeps herself and her patient scrupulously clean. The danger of infection to those who have the care of tuberculous or diphtheritic patients is minimized by the speedy and thorough disinfection of all secretions and discharges that may be the carriers of infectious matter from the patient; by keeping the patient's clothing and person scrupulously clean; and by taking equal precautions with all parts of their own person or clothing that may become soiled with discharges or other infectious agents from the patient.

The third, (c), has a widespread application, as illustrated by the following: A single typhoid fever patient may be ill in some remote spot. If all the excreta from such an individual is thoroughly disinfected, as it should be, there is no danger of the disease spreading to others in the community. If, on the other hand, the excreta is not disinfected before it is thrown upon the ground or into the cesspool or sewer, the typhoid fever bacillus may find its way into the drinking water supply, local or remote, and hundreds or even thousands of cases of typhoid fever may result from this seemingly trifling neglect.

So, too, with tuberculosis, a disease that we are so

careless in our dealings with, while it kills its thousands and tens of thousands. Were simple and practical methods taken to destroy the tubercle bacilli escaping from infected individuals, it would not be long before the number of cases of this disease was reduced to a minimum.

### *II. Among the Dead.*

Our duties in the use of disinfectants do not end with the care of the living. Those who have died of an infectious disease are still capable of infecting others, and this danger may continue for an indefinite period if proper precautions are not taken to destroy all infectious material. It would be a wise measure if the remains of all who die of Asiatic cholera, yellow fever, typhus fever, bubonic plague, anthrax, glanders, leprosy, smallpox, scarlet fever, typhoid fever, diphtheria, tuberculosis, erysipelas, and other infectious diseases were disposed of by cremation, rather than by burial. By such action all danger from infection during the process of decay would be done away with. Again, it is a simple matter to remove the ashes of the dead from one place to another; it is quite an undertaking to remove a casket containing the remains of the dead from place to place; it is often dangerous even, to such a degree as to prohibit entirely the transportation of the remains of those who have died of an infectious disease; still further, the disinterment of the

remains of one who has died of an infectious disease can never be made, even though there may have been careful embalming at the time of death, without some degree of danger.

The danger present in the remains of the dead is made apparent by our action in forbidding public funerals, or the "viewing" of remains under certain conditions; and also by the action of the various national bodies in formulating and placing in force such rules as the following: "The transportation of bodies of persons who have died of smallpox, Asiatic cholera, yellow fever, typhus fever and bubonic plague is absolutely prohibited."

"The bodies of those who have died of diphtheria, scarlet fever, glanders, anthrax or leprosy shall not be accepted for transportation (by any railway or vessel) unless prepared for shipment by being thoroughly disinfected, enveloped in a layer of cotton not less than one inch thick, encased in an air-tight metallic casket or coffin, etc."

"The bodies of those dead of typhoid fever, puerperal fever, erysipelas, tuberculosis or other dangerous communicable diseases not already specified must not be accepted for transportation until carefully disinfected and properly prepared by a competent embalmer."

"Every disinterred body, dead from any disease or cause, shall be treated as infectious or dangerous to the public health and must not be accepted for transportation unless said disinterment has been approved

by the state or provincial board of health having jurisdiction where such body is interred and the consent of the health authorities of the locality to which the corpse is to be consigned has first been obtained; and all such disinterred remains must be encased in a hermetically sealed metallic box."

## CHAPTER II.

### IMPORTANT DISINFECTANTS.

The list of disinfectants is a long one. It is only necessary that we should consider some of the most important.

Taking these up in alphabetical order, we have the following:

**Alcohol:** (Ethylic alcohol): This has been generally classed as a weak antiseptic not to be depended upon where disinfection is required. It has, however, an important place among disinfectants for, through its dehydrating properties, its solvent action upon fatty substances and its tendency to expel the air from the pores of the skin it prepares the way for the further action of agents recognized as having markedly disinfecting properties.

Recent experiments tend to place alcohol among recognized disinfectants, such action being due, when used upon living tissues, to its vaso-dilating properties. Through the increased local supply of blood the bactericidical action of this fluid is intensified.[1] Still further: Alcohol would seem to have both a desiccat-

[1] Journal of the American Medical Association, Apr. 7, 1900, p. 888.—Buchner.

ing and an especial toxic influence upon bacteria.[2] As an antiseptic dressing alcohol is recommended (a 55 per cent solution by weight) in the treatment of local tuberculosis, phlegmonous, or erysipelatous processes; also in the treatment of wound infection received from a cadaver. It is especially the vaso-dilating property of the drug that is wanted in each instance.

**Bromine:** This is a very efficient but dangerous and disagreeable disinfectant. It occurs as a brownish red liquid and at ordinary temperatures gives off a vapor which is very irritating and which has a peculiar suffocating odor. It is seldom used.

**Calx:** (Lime. Quicklime, Calcium Oxide.) This occurs as hard white or grayish white masses gradually attracting moisture and carbon dioxide on exposure to air, and falling to a white powder. Very sparingly soluble in water. It is a most efficient disinfectant for use in the disinfection of stools, etc., being prompt and safe in action, odorless and cheap. For such disinfection it is generally used as a **milk of lime** which is composed of one part by weight of slaked lime (calcium hydrate) with about eight parts of water. This "milk of lime" should be freshly prepared each day in order to avoid the formation and presence of the inactive lime carbonate.

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[2]Journal of the American Medical Association Aug. 18, 1900, p. 433.

**Calx Clorata:** See Chlorine.

**Chlorine:** A greenish yellow, non-respirable gas, having a suffocating odor. Both in the free state and in solution in water it is an active disinfectant. It also has bleaching properties. Chlorine cannot be depended upon as a practical disinfectant because of its lack of penetration and its destructive action on fabrics, etc.

CALX CHLORATA: (Chlorinated Lime, Bleaching Powder): This is a grayish white powder—a compound resulting from the action of chlorine upon calcium hydrate. It should contain not less than 35 per cent of available chlorine. Under certain conditions to be described later this is a useful disinfectant, its action depending upon the available chlorine that it contains.

Hypochlorite of lime. The disinfecting agent of this compound, is readily decomposed by contact with organic matter, and is therefore active as a superficial disinfectant only. It cannot penetrate deeply into masses of organic material.

**Carbolic Acid:** (Obtained from coal tar.) It is in the form of crystals, colorless or whitish, sometimes acquiring a reddish tint; it has a characteristic, somewhat aromatic odor, and a sweetish, burning taste. It is liquified by the addition of eight per cent of water, and in this form is often sold as pure. It is worthy of note that while sixteen parts of water will liquify 184 parts of carbolic acid, it requires sixteen parts of water to dissolve one part of the acid. Mixed with water in greater proportion than one in sixteen, the acid is present in globules which have the action of the 92

per cent acid if brought into contact with living tissue. If a stronger aqueous solution than one in sixteen is wanted glycerine should be added to the mixture, for the acid is very soluble in this agent.

In the past, carbolic acid had a prominent place among disinfectants, but its use is quite limited now, for it has been displaced by safer and more reliable disinfectants. It will destroy bacteria when used in a two per cent aqueous solution with two hours' exposure, but will not destroy spores even when used as a five per cent aqueous solution.

Probably the most important antidote for carbolic acid poisoning is alcohol. If pure carbolic acid is brought in contact with the skin, the part should promptly be rinsed with alcohol. If carbolic acid has been taken internally, alcohol should be given freely. A pint of alcohol or more may be used internally within two or three hours when given for its antidotal properties against carbolic acid.

Crude Carbolic Acid: This has generally been considered more active as a disinfectant than the pure acid, such increased action depending upon the presence of cresols. It is possible now, however, to find a crude carbolic acid that has very feeble disinfecting qualities, the cresols having been removed.

The disinfecting properties of carbolic acid are increased by the addition of a mineral acid, such as hydrochloric or sulphuric acid. A solution containing

four per cent of carbolic acid and two per cent of hydrochloric acid is far more active than the same strength solution of carbolic acid alone. The mixture of equal parts of carbolic acid and sulphuric acid (kept artificially cool while being mixed) used as a five per cent solution, is a most effective disinfectant.

Mixtures of carbolic acid with a mineral acid are not suitable for use when the caustic action of the latter is objectionable. They are well adapted for the disinfection of stools that are to be thrown into pits, and in the disinfection of vaults or cesspools.

**Creolin:** This is a proprietary preparation, said to be composed of one part of resin soap and two parts of a twenty per cent solution of crude carbolic acid. It is a dark brown syrupy liquid which forms a soapy-like mixture with water. It has the disinfecting qualities of crude carbolic acid, and may be used upon the body in a two to five per cent aqueous solution.

**The Cresols:** (Ortho, Para and Meta-Cresol): These products are obtained from crude carbolic acid. They are said to have more marked disinfecting qualities with less toxic action than carbolic acid.

The following are a few of the *cresol* preparations:

**Tri-Kresol:** A proprietary preparation representing the three kresols—ortho-, para-, and meta-kresol; hence the name. It is a white liquid with a creosote like odor and taste; miscible with forty parts of water, forming a clear solution. This acts as a germicide

even in the presence of albumin. It has the general action of carbolic acid. At the same time it is said to be more efficient, less irritating, and less toxic than carbolic acid. One per cent in solution is said to be as active as three per cent of carbolic acid. It is used in one to five per cent aqueous solution.

**Lysol:** This is a proprietary preparation said to contain fifty per cent of cresols with neutral potash soap. It is a brown, oily liquid with a creosote-like odor. With water it forms a soapy, frothing solution. It is also mixible with alcohol, chloroform, ether, glycerine, etc. It has the disinfecting qualities of crude carbolic acid and is said to be more active and less toxic than this agent.

**Copper Sulphate:** (Blue vitriol.) This has been used extensively as a cheap disinfectant, but it is by no means an active agent, and should be displaced by more reliable disinfectants. It occurs in the form of large translucent deep blue crystals; odorless, having a nauseous, metallic taste, and an acid reaction.

**Electricity:** At the present time we hear more or less of the use of electricity as a disinfectant in the treatment of sewage under the Webster, Hermite or Woolf processes.

All of these methods depend upon securing chemical disinfecting products as the result of chemical decomposition produced by the action of an electrical current. None of them have yet proved to be efficient or practical.

**Formaldehyde:** This is undoubtedly the most important disinfectant in use at the present time. It is a gas, and is found in the market as an aqueous solution containing from thirty-five to forty per cent of available formaldehyde gas. It has a disagreeable, penetrating odor and is quite irritating. Its normal penetrating qualities are not great. It has the property of uniting with gelatin and with albumin to form insoluble compounds.

To secure the gas in a dry state calcium chloride should be added to the formaldehyde solution and the mixture heated under pressure. This raises the boiling point of the liquid and the gas is expelled before the water of the mixture is given off as steam. The addition of ten per cent glycerine to the formaldehyde solution tends to prevent polymerization. Formaldehyde, as a rule, has no injurious effects upon fabrics, colors or ordinary articles of dress or furniture. Iron or steel are acted upon by the gas if moisture is present.

The action of formaldehyde is greater in the presence of moisture or *in vacuo*.


FORMALDEHYDE SPRAYING APPARATUS USED BY CHICAGO BOARD OF HEALTH.

The gas is more active in comparatively high than in low temperatures. The temperature of the room, therefore, when disinfection by means of formaldehyde gas is in progress, should, if possible, be kept at 80° F.

As to the quantity of formaldehyde to be used in disinfection: Eight ounces (240 c. c.) are generally given as the required quantity, of a 40 per cent solution of formaldehyde, for each 1,000 cubic feet of space. This quantity is too small to secure safe results. It is better to use 12 (360 c. c.) or even 20 ounces (600 c. c.) for each 1,000 cubic feet of space.

Ammonia gas neutralizes the disagreeable odor of formaldehyde.

Various methods of securing formaldehyde gas have been employed, such as the oxidization of wood alcohol, the volatilization by heat of paraform, or the application of heat to an aqueous solution of the gas.

The last seems to be the most satisfactory method and is accomplished by means of "formaldehyde generators," such as those of Trillat, Kny-Scheerer, Lentz, etc.

The Chicago Board of Health has devised a special sprinkler with which an ordinary sheet suspended in a room is sprayed with 180 c. c. (six ounces) of a forty per cent solution of formaldehyde. This quantity is considered sufficient to disinfect one thousand cubic feet of space. (See p. 23).

The fact that the Health Department of Chicago has found it necessary, because of the large amount of disinfection which it is called upon to do, to adopt the method which it pursues on the score of time, suggests the need of an apparatus for use in large cities, in which the gas may have been first generated, or in which the generation may go on so rapidly that it will be possible to force the gas into the building, which may have first been prepared to receive it.

The St. Louis Health Department has still another apparatus constructed with the idea of saturating the air with moisture in order to increase the action of the formaldehyde. This apparatus consists of a copper kettle supported on a tripod and under this copper kettle is a peculiarly constructed but simple alcohol lamp. Water is placed in the copper kettle and the alcohol lamp lighted. When the water boils a forty per cent aqueous solution of formaldehyde is added in the proportion of one part to three of water. In room disinfection twenty ounces of the formaldehyde solution are used for each one thousand cubic feet of space. (See p. 31).

The fact that some experimenters urge the use of the dry gas, while others urge its use only in the presence of moisture, is somewhat confusing. As a matter of fact the dry gas has greater power of penetration, while the gas in the presence of moisture has its action as a superficial disinfectant increased.

ROOM READY FOR SPRAYING—CHICAGO SYSTEM.

SPRAYERS AT WORK—CHICAGO SYSTEM.

THE FRANCIS GENERATOR ORIGINATED BY ST. LOUIS BOARD OF HEALTH.

*Formaldehyde gas is superior to sulphur dioxide as a disinfectant for dwellings, (1) because it is more efficient and rapid in its action; (2) because it is less injurious in its effects on household goods; (3) because it is less toxic to the higher forms of animal life; (4) because when supplied from a generator placed outside of the room and watched by an attendant there is less danger of fire. Formaldehyde gas is the best agent at present known for the disinfection of dwellings.

**Formochloral.** This is a proprietary preparation consisting of "a saturated solution of formic aldehyde and a neutral and indifferent mineral salt, whereby the evolution of formaldehyde vapors can be produced in an unpolymerized condition when heated even under pressure." It may be used in some of the formaldehyde generators.

**Heat.** Under this head will be considered hot air and steam.

Fire. This is the most thorough means of disinfection that we have at our command and should always be used when there is no objection to the absolute destruction of the infected articles, or when the question of safety is of greater importance than the value of the infected articles.

Dry Heat: This is not nearly so efficient as moist heat and is seldom used for disinfecting purposes.

*American Year Book of Medicine and Surgery, 1900.

Moist Heat: Boiling for half an hour will destroy all known disease germs. Whenever we have to deal with articles that can be heated in this way it is one of our best known methods of disinfection. Of course, in dealing with large masses of clothing in a boiler care must be taken that all parts are subjected to the boiling temperature. It may take some time to bring this about in the interior of the mass.

Steam Under Pressure: The temperature of compressed steam varies with the pressure of the steam gauge; thus, with twenty pounds pressure the temperature is about 230° F.; at twenty-five pounds, about 240° F., etc. A boiling temperature will require some time to destroy spores. Steam at a temperature of 240° F. requires but a moment to destroy the most resistant of spores. For such use of steam it is necessary to have specially constructed apparatus. With steam introduced into cylinders under pressure, but without a continuous outlet "dead spaces" are found when the temperature is 212°. Mattresses, pillows, etc., are penetrated slowly, by still steam but rapidly by flowing steam. If there is close packing of articles in a steam sterilizer they are apt to become quite wet. Drying is hastened by the use of the vacuum following the introduction of still steam, or by the use of flowing steam. Disinfection with steam can be carried on to a limited degree in an ordinary wash boiler, containing a small quantity of water with the articles to be disin-

fected supported upon an extemporized false bottom resting in the boiler upon blocks of wood or bricks.

**Iron Sulphate** (Green Vitriol). This is one of the old agents used for disinfecting purposes. It is not reliable, however, and should be displaced by more efficient chemicals.

**Light:** This is one of our most efficient germicides.

Whenever possible, infected clothing, furniture, etc., should be exposed to the direct rays of the sun. Sunlight should be directed into the sick room at frequent intervals. It is not practical to attempt to secure disinfection by these means alone, but sunlight is a useful adjunct in the attempt to secure daily disinfection of articles exposed to infectious material.

**The Mercurials:** All of the soluble salts of mercury are active disinfectants. Practically, however, mercuric chloride (corrosive sublimate) is the only salt used. It occurs in colorless crystals or whitish masses. It is soluble in sixteen parts of water and its solubility can be increased by the addition of potassium iodide. It is an irritant poison and has a corroding action upon metals. Plain metallic dishes should not be used in making up solutions of this drug. In the presence of albumin an insoluble albuminate of mercury is formed. Should such a chemical change occur the disinfecting properties of this agent are interfered with. The addition of tartaric, citric or hydrochloric acid to a solution of corrosive sublimate

tends to prevent the formation of an insoluble albuminate and thus increases the disinfecting properties of the mercurial. Ammonium chloride also increases the disinfecting properties of corrosive sublimate.

There are in the market tablets containing corrosive sublimate 7.7 grains, ammonium chloride 7.3 grains. One of these tablets dissolved in a pint of water will give a one to one thousand parts solution of corrosive sublimate—the ordinary strength used for disinfecting purposes. These tablets are usually colored blue, thus giving them a distinctive appearance and tending to prevent accidental poisoning as might often occur were not this precaution taken, through the administration of these tablets by mistake for other drugs having a similar general appearance in tablet form.

**Mustard:** This has deodorizing and antiseptic erties, due to the volatile oil developed from it in the presence of moisture. The custom in vogue of late of the surgeon preparing himself for an operation by first using mustard flour with water in washing the hands and arms; following this with a saturated solution (one in sixteen) of permanganate of potash; finally removing the potassium permanganate stain with a solution of oxalic acid (one in sixteen) is a good one. This proceeding is especially suitable where deodorants as well as disinfectants are called for, as after operation upon suppurating surfaces, or after post mortems, etc.

**Hydrogen Dioxide:** (Peroxide of Hydrogen): This is a useful cleansing agent with mild disinfecting properties. It is found in the market as an official solution *(solution of hydrogen dioxide)* which should contain when fresh about three per cent, by weight, of pure hydrogen dioxide corresponding to about ten volumes of available oxygen. It is a colorless liquid, without odor, having a slightly acidulous taste and producing a peculiar sensation with frothiness in the mouth. This solution readily gives off oxygen and when added to pus it causes disintegration with effervescence. It may be used in full strength, applied with a pledget of cotton, to remove accumulated pus on secretions from the eyes, nose, or various discharging surfaces upon the body.

**Potassium Permanganate:** This is a useful deodorizer and has a limited action as a disinfectant. It occurs as crystals having a deep purple color, soluble in sixteen parts of water. In solution it still maintains its purple hue, but if any organic matter is added to the solution decomposition follows and the purple tint is changed to that of a dirty yellow. If any part of the body is washed with a solution of permanganate of potash the stain of the drug is imparted to the skin, but this can readily be removed by the use of a solution (one in sixteen) of oxalic acid.

**Sulphur:** Until the introduction of formaldehyde gas, sulphur held first place as an aerial disinfectant. Nevertheless, its properties were seldom understood

and its action amounted to practically nothing. Sulphur dioxide produced in the burning of sulphur has little germicidal action. It is a non-respirable gas and will kill the higher forms of animal life. It will also destroy plants, but it has little if any action, when used by the ordinary methods for disinfection, upon bacteria or their spores.

Sulphur dioxide in the presence of moisture is quite another thing. It combines with the water and gives us a most efficient germicide. At the same time it becomes one of the most undesirable of disinfectants, for it will destroy colored fabrics, ruin wall paper or painted surfaces, discolor and corrode metal surfaces; in fact, it will practically ruin many of the articles which we may wish to disinfect. Sulphur is therefore either a useless or a destructive disinfectant, and should be entirely displaced by formaldehyde in the disinfection of dwellings, clothing, etc.

When sulphur is used for disinfecting purposes, a quantity should be placed in an iron kettle (at least three pounds for each thousand cubic feet of air space in the room) and upon this should be poured four ounces or more of alcohol. For safety the kettle containing the sulphur should be placed in a tub partly filled with water, the kettle resting in the tub on bricks. With the room thoroughly sealed and all in readiness, the alcohol on the sulphur should be lighted. If possible, steam should be conducted into the room where the sulphur is burning.

Dr. H. D. Geddings, of the United States Marine Hospital Service, in discussing the efficiency of sulphur dioxide as a germicidal agent (Bulletin No. 3, Lab. Hygiene M. H. S.), emphasizes the fact that it is open to the serious objections of slight penetrating power, and, at the same time, destructive action upon textiles and fabrics. That the destructive effects of the gas are the strongest arguments against its employment; that it should never be employed where its destructive action is objectionable when it is possible to employ other agents equal to or superior in efficiency. He lays stress on the importance of the *hydration* of the gas when employed as a disinfecting agent, relating an experiment in which it is shown that a ten per cent volume of the gas failed to exert a germicidal influence on the bacillus of anthrax, cholera, typhoid fever, diphtheria, etc., under an exposure of forty-eight hours, while the same organisms, with the exception of anthrax, were killed after an exposure of twenty-four hours to a six-tenths per cent atmosphere of the gas in the presence of moisture, thus demonstrating the high germicidal action of sulphurous acid. After detailing several experiments he arrives at the conclusion that a five per cent atmosphere of sulphurous acid for sixteen hours is an efficient germicidal agent and may be used where its destructive properties offer no objections.

**Zinc Chloride:** This was formerly much used as a disinfectant. It is a weak and unreliable agent, and should not be depended upon.

The same is true of zinc sulphate (white vitriol).

## CHAPTER III.

### TESTS OF DISINFECTANTS.

These are made by subjecting known bacteria or spores to the action of the disinfectant to be tested. The disinfecting properties of heat are shown in the following table:

*THERMAL DEATH POINT OF CERTAIN PATHOGENIC BACTERIA.

| | Determined by | Centigrade | Fahrenheit | Time of exposure in minutes |
|---|---|---|---|---|
| Cholera Spirillum..... | Sternberg.. | 52° | 125.6° | 4 |
| Typhoid bacillus..... | Sternberg.. | 56° | 132.8° | 10 |
| Anthrax bacillus..... | Chauveau. | 54° | 129.2° | 10 |
| Glanders bacillus..... | Loffler..... | 55° | 131.° | 10 |
| Diphtheria bacillus... | Loffler..... | 60° | 140° | 10 |
| Streptococcus of Erysipelas..... | Sternberg.. | 54° | 129.2° | 10 |
| Diplococcus of Pneumonia..... | Sternberg.. | 52° | 125.6° | 10 |
| Anthrax Spores..... | Sternberg.. | 100° | 212° | 4 |
| Bacillus Tuberculosis..... | Schill and Fischer..... | 100° | 212° | 4 |

*From Hares' Practical Therapeutics, Vol. I, page 577.

This table shows that a temperature of 60° C (140° F) is fatal in each case submitted with the exception of the tubercle bacillus and anthrax spores. In this connection the following table, showing the disinfecting qualities of certain drugs, may be of interest:

*ACTION OF A FEW DRUGS ON BACTERIA.

| | Prevents the reproduction of undeveloped bacteria | Kills developed bacteria | Prevents the reproduction of spores |
|---|---|---|---|
| Corrosive Sublimate.. | 1 in 10250 | 1 in 5805 | 1 in 6500 |
| Chlorine..... | 1 in 4911 | 1 in 22768 | 1 in 1008 |
| Chlorinated Lime..... | 1 in 488 | 1 in 3720 | 1 in 109 |
| Sulphurous Acid..... | 1 in 135 | 1 in 2009 | 1 in 325 |
| Bromine..... | 1 in 769 | 1 in 2550 | 1 in 493 |
| Sulphuric Acid..... | 1 in 205 | 1 in 2020 | 1 in 306 |
| Salicylic Acid..... | 1 in 343 | 1 in 60 | 1 in 603 |
| Carbolic Acid..... | 1 in 22 | 1 in 22 | 1 in 22 |

*From Brunton's Pharmocology.

## CHAPTER IV.

### DISINFECTING APPARATUS.

The Trillat Autoclave represents one of the best formaldehyde generators. Its price, however, one hundred dollars, together with its great size, make it an impractical apparatus for general disinfection. This apparatus is packed in two cases described as follows:

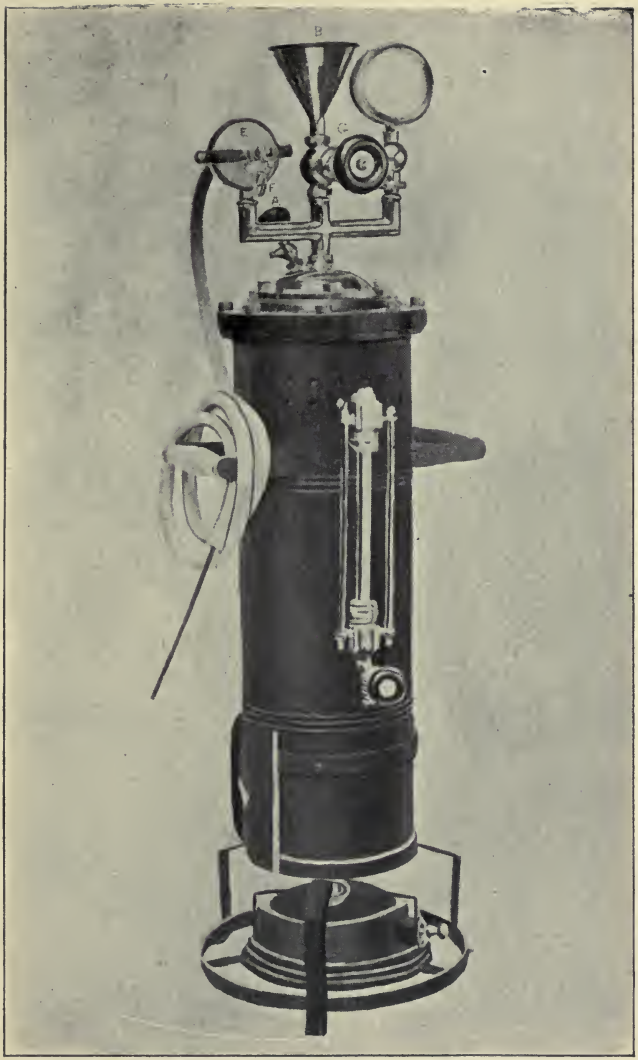
Autoclave Case.—Autoclave, with gauge; thermometers; two handles; tin case containing two outlet tubes and a wire to clean same.

Case of accessories.—Special lamp and small can, containing alcohol to light same; copper can, for formochloral; tin can for kerosene; wadding for stuffing cracks in windows, doors, etc.; pair of spectacles, and nose pincers.

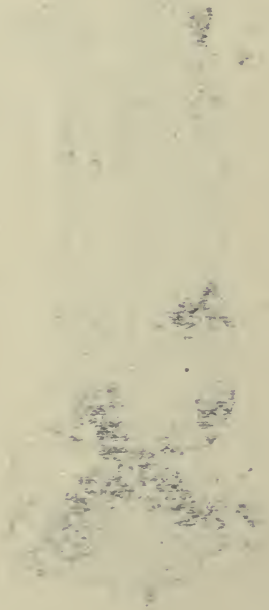
The vessel of the apparatus is made of heavy copper which is silver lined, and has a capacity of about 4 liters (about 1 gallon). The remainder of the apparatus is mostly brass, highly polished and carefully finished.

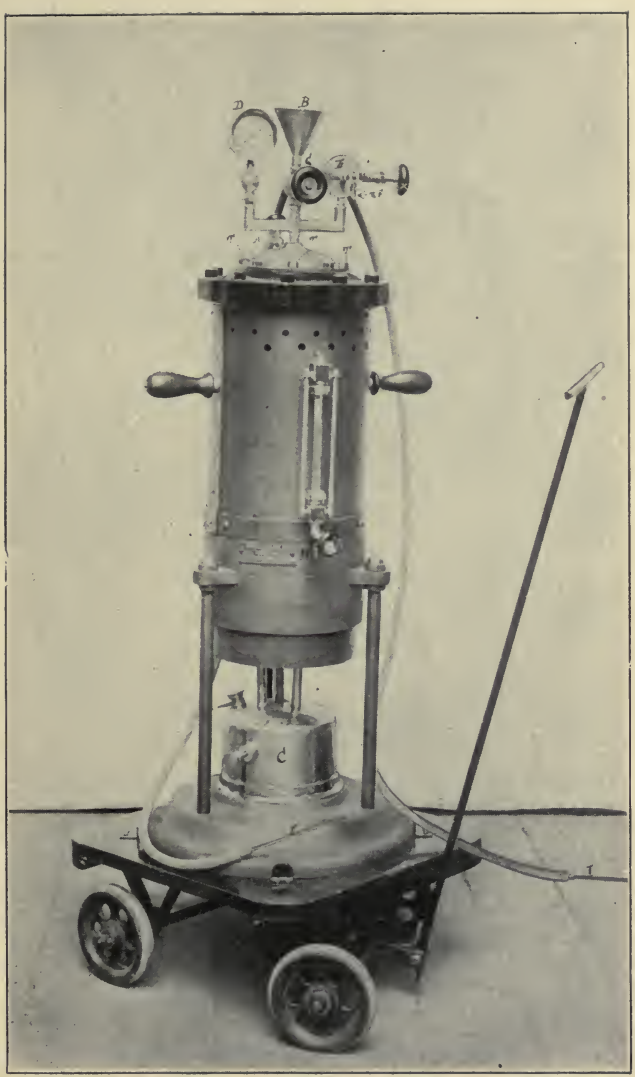
The cover of the autoclave, which rests on a rubber band so that it can be tightened to avoid any leakage, is equipped with a pressure gauge, a tube in which the thermometer is placed, and a stopcock by which one regulates the escape of formaldehyde gas.

The apparatus is heated by means of a Bunsen burner, or special lamp, which flame is fed by kerosene




THE KNY-SCHEERER GENERATOR NO. 2.






KNY-SCHEERER GENERATOR. NO. 3.

vapors. By the small screw one can regulate the flame, and by using the pump occasionally one can increase the heat.

The generators which are shown in the accompanying cuts are sufficient for all ordinary purposes.

The Kny-Scheerer formol generators are of three forms. Numbers 1, 2 and 3.

Number 1 is for use in the disinfection of rooms. "It has a capacity of 4,000 cubic feet and will hold 32 ounces of the formaldehyde solution. It is provided with a safety valve, throttling valve for the close control of the gas, gauge glass, and five feet of rubber hose, and nozzle." Number 2 is for use in disinfecting large rooms or apartments. It has a capacity of 8,000 cubic feet, and will hold 64 ounces of the solution. It is provided with a pressure register gauge in addition to the items named for Number 1.

Number 3 is intended for the use of boards of health and large public institutions. It has a capacity of 20,000 cubic feet and will hold 128 ounces of the solution. It is provided with a safety valve, pressure registering gauge, a throttling valve, rubber hose, discharge nozzle, etc. It is also provided with a specially constructed truck with rubber tired wheels.

One of the most useful formaldehyde generators is shown on page 49. This apparatus consists of a stout copper retort, of 4 pints capacity, with aperture at top, and cover or stopper held in position by the thumb-screw and yoke "B."

Two brass tubes enter the stopper. The inclined or outlet tube is connected by a short length of flexible rubber tubing with the smaller brass tube, which is introduced through the keyhole of the room to be disinfected. The second tube entering stopper extends to within 1-16 inch of the bottom of retort, and serves as a level indicator to indicate when the solution has nearly all evaporated by liberation of vapor. It is provided with a copper funnel for refilling without stopping the operaton. This tube can be closed by means of the stopcock "A" and is merely opened for a few seconds towards the end of the operation to see whether the retort is nearly empty, as the gas will then escape through the orifice of cock.

The apparatus is heated by means of a special Primus blast lamp, burning kerosene oil, which requires no wick. This style of burner is familiar to every plumber, and is very simple in its action, giving perfect satisfaction. It requires no attention after lighting, beyond pumping for a few seconds, about once every hour, by the piston "G." The lamp can be instantly extinguished by one turn of the thumb-screw "F." It will burn for several hours with one filling, and is very far superior and much more economical than alcohol or illuminating gas.

The retort is recessed into a ring, which is firmly braced in position by four brass supporters or bands. It can be removed by the turn of a screw at "C" and the lamp itself can be instantly extinguished and re-


THE LENTZ GENERATOR.

THE MULFORD GENERATOR.

moved from the supports. The whole apparatus is firmly braced together, and can easily be carried by the handle when filled for use. It is very strongly made, and is well finished and polished throughout. It is constructed entirely of stout polished copper and brass. This is known as the Lentz generator.

The Mulford generator, which is shown on page 51 consists of a cylindrical copper receiver, with a dome connected with the receiver, a shallow reinforced heating chamber marked D beneath the receiver B, communicating by a tube and conveying pipe E with a rubber hose through which the formaldehyde gas is conducted to the room to be disinfected. The gas is generated with the aid of a Swedish heating lamp. The illustration is accompanied by an outline cut showing the internal construction of the generator.

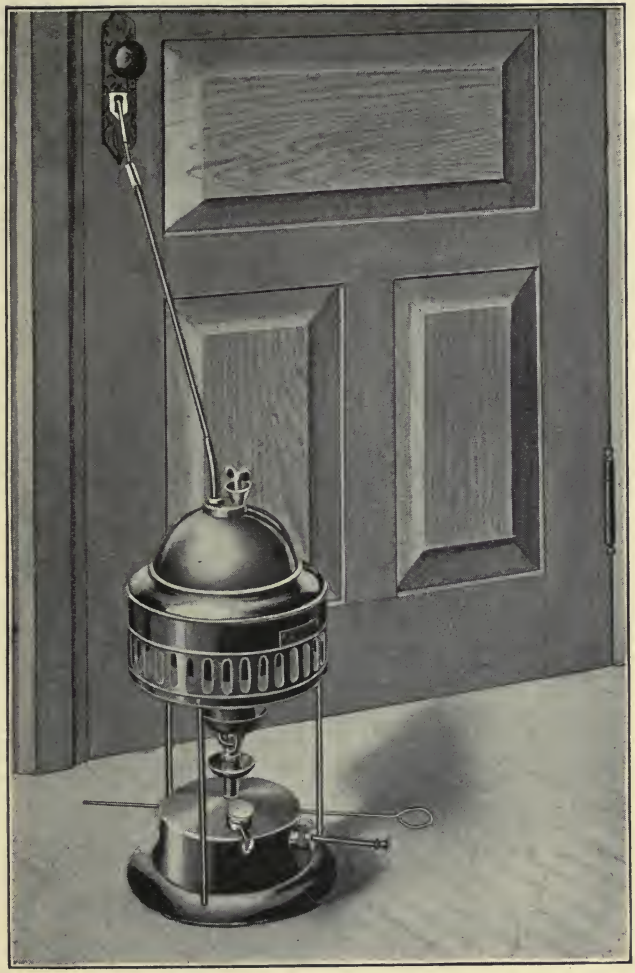
A quantity of solution of formaldehyde is put into the receiver B through the opening A; the heating lamp is lighted, and the chamber D brought to a red heat. The solution of formaldehyde in receiver B is vaporized, rises to the top of the dome C, passes down the pipe to the heating chamber D, where the gas is not only superheated but also thoroughly dried, and passes through the pipe E. The gas is thus superheated, dried and purified as it passes from the chamber B into the room or apartment being disinfected.

On page 55 is shown a generator made by Park, Davis & Co., which is simple in form, of less capacity, however, than some of the others shown and com-

paratively inexpensive. The principle upon which it is operated is substantially the same as that of the others here described.

On page 57 is shown a generator made by W. E. Pettis, which has been much used by embalmers. It consists of a copper cylinder held over a lamp tube extending from the center of the top of the cylinder.

On page 59 is shown the Kuhn formaldehyde generator. This is one of the direct type in that it generates formaldehyde by the passage of the vapor of wood or methyl alcohol, mixed with air, over incandescent platinum in a state of fine division. The most important feature of the apparatus is the immersion of the lower end of the cylinder carrying the disks and cone in water. This acts as a water seal and the only air admitted to the alcohol is passed through a series of small openings which are carefully gauged to supply just a sufficient quantity for the partial oxidation of the alcohol vapor. In addition, the water forming this water seal is slowly volatilized during the process of combustion, and hydrates the formaldehyde evolved, thus giving it a much more penetrating effect and rendering it more highly germicidal. The apparatus is simple in design, absolutely safe from any danger of explosion, and cheap to operate. It is said that one quart of standard methyl or wood alcohol will disinfect 2,500 cubic feet of space.



PARKE, DAVIS & CO. GENERATOR.

THE REX GENERATOR.

THE KUHN FORMALDEHYDE GENERATOR.


THE SCHERING-GLATZ FORMALIN GENERATORS.

Differing from all the preceding formaldehyde generators are those of Schering, shown on page 61.

In these, "formalin pastils" said to contain 100 per cent of pure formaldehyde are vaporized, thus setting the formaldehyde gas free. In certain experiments with various formaldehyde generators carried on under the supervision of a friend of the writer the comparative results were not at all favorable to these lamps. Dr. H. W. Hill, of Boston, in his remarks upon formaldehyde disinfection made before the American Public Health Association, November, 1899, stated that in a comparison of the Schering "formalin pastils," with standard formalin solutions used in disinfection, the same results could not be obtained cost for cost from the former as from the latter. He further stated that a certain quantity of formaldehyde gas obtained from the pastils would produce an effect equal to that produced by the same quantity of gas obtained from the standard solutions, but that to secure such an equivalent of gas it was necessary to use such a large number of pastils as to make the cost too high for ordinary house disinfection.

## CHAPTER V.

### SURROUNDINGS OF A PATIENT ILL WITH AN INFECTIOUS DISEASE.

It is important that all who have anything to do with those patients suffering from an acute infectious disease, or with any material from such individuals, should be extremely careful.

Isolation must be complete either in a quarantine hospital or in a room that is separated from the rest of the house. If the patient is quarantined in the room of a house where people not infected are living, a wet sheet should be hung in the doorway of the room. A jar containing water, with a syphon attachment, can be so arranged as to keep the sheet wet, or, better still, if possible, all communication between the room and other parts of the house should be cut off, the quarantined room being reached through an outside door or window. The place of quarantine (hospital or room) should be furnished as plainly as possible; plain iron bedsteads or cots, cheap mattresses and pillows that can be burned when the quarantine period is over; plain bed clothing that can easily be washed; plain wooden chairs. Hangings, drapery or upholstered furniture should not be allowed

in the place. The nurse should be dressed in wash goods. The nurse and patient should have no direct communication with those not in quarantine.

The passing out of notes, letters, papers, books, clothing, etc., from the sick room should be absolutely forbidden. Food and other necessary articles for the patient or nurse can be placed at some convenient point where the nurse may find them. Everything going from the sick room—dishes, clothing, excreta, etc., etc., should be placed, in receptacles containing a disinfectant, outside the sick-room, where an attendant can secure and remove them without coming in contact with either the nurse or patient and without having to enter the quarantined room or rooms. For disinfecting dishes, a pan containing a five per cent solution of carbolic acid in water should be used, the whole to be boiled before removing the dishes from the pan. For disinfecting bed clothing, clothing, napkins, handkerchiefs, etc., a pail or tub containing a five per cent solution of carbolic acid in water should be used. For disinfecting the stools, diluted "milk of lime"* is the best agent. A sufficient quantity of milk of lime should be prepared each morning to last through the day; of this, ten per cent in water should be added to each stool in sufficient quantity to cover it completely and left standing for at least two hours before emptying into sewer or pit.

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*Milk of lime consists of one part slaked lime with eight parts of water. (See Page 17.)

For the patient, warm baths with plenty of soap should be used freely. Bathing in disinfectants is hardly necessary and may give trouble, for a drug desquamation may be produced that might be mistaken for the disease desquamation. It is well to anoint the body after each bath with some inoffensive non-irritating application, during the whole progress of the disease. This increases the patient's comfort.

The patient, having thoroughly recovered, should be given a final and complete bath and dressed in entirely fresh clothing throughout.

All persons who have been with a patient ill with an acute infectious disease should have a full bath and a complete change of clothing before again coming in contact with those not infected.

It is not possible in the homes of the poor to carry out such methods of isolation and care in the efforts to control infectious diseases as are outlined above. It often is not practical with those in more elaborate homes to do so. Hence the absolute necessity for well constructed and well equipped special hospital for the care of infectious diseases; hospitals that are capable of giving all the comforts of the home from which the patient has been removed.

## CHAPTER VI.

### PHYSICIANS IN ATTENDANCE UPON PATIENTS WITH AN INFECTIOUS DISEASE.

Physicians are often too careless when in attendance upon those ill with an infectious disease. In this respect they are in strong contrast with their professional brothers, the surgeons, who, while none too cautious, are extremely careful in their dress and habits. There is no reason for such difference. The surgeon will not go from a postmortem or from a septic dressing to a patient without taking every precaution possible in the way of antiseptic cleansing and change of clothing. On the other hand, it is no uncommon thing for a physician to visit cases of diphtheria, scarlet fever or even smallpox without any special protective clothing, and to go from such patients without having taken any special precautions to visit other patients who should be protected from all possible infection because while free from infection themselves they are less resistant to infection than they would be were they in good health. The surgeon will hesitate, even with his usual precautions, before passing from an erysipelatous patient to an operation upon some other non-infected patient. Too

often the physician, unless restrained by public opinion, will go from a scarlet fever patient to the bedside of the woman in confinement. Such negligence on the part of a physician is criminal and may be the cause of the death of a patient. Every physician when visiting a patient suffering from an infectious disease, the contagium of which may be carried by him to others, should wear a gown like that shown in the illustration on page 69, or some other equally protective dress. Such a gown should be carried as an individual parcel rolled up in a strip of rubber sheeting and fastened with a shawl strap as shown in the illustration. It is well to sprinkle the gown thoroughly with a solution of corrosive sublimate before starting out to visit a patient suffering from an infectious disease. The rubber covering will keep the gown moist indefinitely. The gown should be damp when it is put on just prior to visiting the patient. Any infectious material that may come in contact with it will then adhere to it and be destroyed. If on account of extremely cold weather it is not practical to carry a wet gown, it should then be thoroughly disinfected after each day's use by immersion in a corrosive sublimate solution, allowing it to dry during the night and thus become ready for use again the next day.

Sometimes an old suit is worn by a physician when in attendance upon transmissible disease with the intention of exchanging it for clean clothing before

DISINFECTING SUIT FOR A PHYSICIAN.

proceeding to visit non-infected patients. Such action is not sufficient. As well might the surgeon use the same gown in which to operate time after time without its having been sterilized between operations. A suit used in the manner suggested above may have upon it the contagium of the disease visited by the physician, and this contagium may then be more readily transferred to the wearer of the suit than it would have been from the infected patient. At times a rubber coat is slipped on over the general clothing to serve as a protectant. This, like the old suit, is worse than no protection at all, unless after each wearing it is thoroughly sponged over with an antiseptic solution. At times a physician may find himself forced to visit an infected patient without any protecting gown. Under such conditions it is no uncommon thing to see the physician carefully remove his hat, overcoat and even his coat before entering the sick room. The least reasoning possible should convince one that such action is wrong. If one must visit an infected patient without a protecting gown let it be done with the overcoat well buttoned, the collar turned up, the hat on the head and even the gloves on the hands, unless there is good opportunity to wash the hands in an antiseptic solution upon withdrawing from the sick room. Under such circumstances the attending physician should take a walk or drive in the fresh air, the longer the distance the better, before visiting other patients. He certainly should avoid public convey-

ances or groups of people until there is a reasonable possibility of his having been relieved of infection that may have been adhering to his outer clothing. The physician who is visiting both infected and non-infected patients should make it a point, so far as possible, to visit the infected ones at the end rather than at the beginning of his rounds.

## CHAPTER VII.

### THE DISINFECTOR.

When the time comes for the disinfection of the sick-room and its occupants, a most important duty is to be performed in order to protect the general public, and none but trained and conscientious disinfectors should be entrusted with this duty. Unfortunately, it too often happens that when the physician's duties cease, those of the undertaker begin. It is certainly important, therefore, that he should know what to do and how to do it, for by doing the right thing he protects not only himself, but the public at large. It is not practical for the disinfector, or embalmer, to wear such a gown while at his work in the infected room as that recommended for the physician. He should have an outfit like that shown in the illustration on pages 75, 77. It may be that it is necessary for him to give immediate attention to the remains of the dead. If so, his suit should be moistened and put on and his mouth and nose protected by some covering. The remains should then be properly washed with a disinfectant and injected with a reliable disinfecting fluid.

It is much better, when posible, after death from smallpox, scarlet fever, diphtheria, etc., to use formaldehyde as an aerial disinfectant in the room where the

remains are lying before doing anything with the dead body itself. When this is not possible the greater care will be necessary on the part of the undertaker for the protection of himself and others. After the remains have been cared for, the room and its contents must be further disinfected by some competent person—this may be a physician, a trained nurse, a trained disinfector or the embalmer. It is not often that a physician is willing to do this work. In many instances there is no trained nurse or disinfector at hand. The embalmer is undoubtedly the best one in many instances to be intrusted with this work. If he undertake the task, he should be familiar with the responsibility resting upon him and should perform his duties as a disnfector conscientiously. First an aerial disinfectant should be used in the room and the best one is undoubtedly formaldehyde. After this formaldehyde disinfection the room should be entered; all personal clothing and bedclothing should be placed in an antiseptic solution prior to washing, or placed in a pile for further treatment with formaldehyde, or burned. Carpets, furniture, woodwork, walls, floors, etc., must be disinfected as directed further on in this work. Finally the room must be freely aired out before being again used for habitation.

A DISINFECTOR DRESSED FOR SERVICE.

THE DURFEE DISINFECTOR SUIT.

## CHAPTER VIII.

### SPECIAL DISINFECTION.

**1. Of Clothing.** All washable clothing should be placed in some reliable disinfecting solution as soon as removed from the patient or from his bed. Carbolic acid or other coal tar products of this type, are undoubtedly the best disinfectants for such use. Corrosive sublimate, while efficient, is objectionable, because should the clothing be in contact with a metallic surface when this drug in solution is used, it would in all probability be stained or even ruined. A formaldehyde solution might be used but there is no good reason for so doing.

All articles of clothing from the patient or his bed that are not injured by soaking in a disinfecting solution can safely be treated by boiling or steaming, and such precautions should always be taken. In fact, the use of the disinfecting solution should be looked upon as only temporary protection, to be depended upon only until such time as disinfection by boiling or steaming can be carried out.

**2. Of Rooms.** There is no practical gaseous disinfectant that can be used in the sick-room. The occasional attempts at such disinfection by people who know no better are simply annoyances to the in-

mates of the room. Some of you may have seen sulphur burned in a sick-room. Were this agent used sufficiently strong to act as a disinfectant the patient and all attendants would be killed as well as the disease germs.

All that can be done, therefore, towards disinfecting the sick-room while still inhabited, must be accomplished through the use of disinfecting solutions used in the cleansing of bedding, furniture, walls, floors, etc.

After the removal from a room of one who has been ill with an infectious disease, it should be disinfected most thoroughly. All windows and doors, except one for exit for the disinfector, should be closed and sealed with strips of paper pasted over the cracks. See illustration page 81. When all is in readiness to liberate the disinfecting gas, the disinfector should finally withdraw from the room, closing tightly the door or window through which he makes his exit.

When sulphur is used as the disinfectant the following course should be pursued: Place a large wash-tub partially filled with boiling water in the center of the room. In this tub of hot water place an iron kettle resting upon bricks or some other solid substance. In the kettle place a quantity of crushed brimstone (three pounds for each thousand cubic feet of space) and pour over this some alcohol. (About four ounces). When all is ready light the alcohol on the sulphur and withdraw from the room. The water in the tub serves a double purpose. (1) It pro-

CRACKS AND CREVICES STOPPED WITH PAPER PASTERS.

DORMITORY PREPARED FOR DISINFECTION.

tects against the danger of fire spreading from the burning sulphur and alcohol in the kettle. (2) It supplies moisture in the room—a necessity with sulphur disinfection.

**In the use of** formaldehyde as a disinfector it is best to choose an apparatus that can be operated outside of the room, the gas being conducted into the room through some small aperture.

The room should be kept closed for a period of at least five or six hours after the introduction of the disinfectant.

Further disinfection of the contents of the room: **After aerial** disinfection the contents of the room or house should be divided into three groups:

(a) Articles that can be disinfected by boiling or washing.

(b) Articles that can be disinfected by further treatment with formaldehyde.

(c) Articles that must be burned.

Washable clothing, sheets, etc., should be placed for a time in a five per cent solution of carbolic acid in water. They should then be removed and placed in boiling water, where they should be kept for at least half an hour.

Certain articles, presenting a free surface and not too thick, such as carpets, blankets, curtains, etc., can be made comparatively safe by thorough disinfection with formaldehyde. Furniture that will stand washing, such as plain chairs, tables, bedsteads, etc., should

be washed with a solution of corrosive sublimate in water, one part in one thousand. Upholstered furniture, mattresses, pillows, feather beds, and all articles that would be spoiled by such methods of disinfection as have already been described, should be burned.

Further disinfection of the room: After the removal and disinfection of the contents of a room the room itself should receive careful attention. If the walls are papered the paper should be soaked off with a one to one-thousand parts solution of corrosive sublimate in water, and the walls, windows, woodwork, floors, in fact, everything about the room, should be washed with a similar solution. It is a good plan to repaint all woodwork.

After everything has been thoroughly disinfected, still further precaution should be taken by allowing the most complete ventilation possible of the room. Articles of clothing or furniture should be placed in the open air and exposed to the sunlight, if possible, for several days.

**3. Of Individuals.** (a) For the persons exposed. (b) For the patient. When it is known that people have been exposed to an infectious disease, they should, if possible, be removed from further exposure and given a disinfecting bath of corrosive sublimate, carbolic acid or other reliable disinfecting agent. It must be borne in mind that corrosive sublimate should not be used in a metallic bath tub, unless porcelain lined. After the bath and

a complete change of clothing, individuals may be released from quarantine, provided they will stay away from those diseased, and provided they are kept under close observation until the incubation period of the particular infectious disease to which they have been exposed has passed

(b) Disinfection of the patient is for two purposes: (1) His own comfort and safety. (2) Protection of others. 1. When the infection is followed by much superficial inflammation or suppuration, as in smallpox, the use of local disinfectants or antiseptics are indicated for the same purpose as in the surgical care of suppurating wounds—to limit or prevent suppuration. 2. The constant use of disinfectants or antiseptics in the form of baths or lotions may tend to destroy the contagium as it is given off from the body surface and may thus tend to diminish the danger of infecting others.

**4. Of the Dead.** This is a very important duty; otherwise disease may be spread far and wide. The remains of all those who die of an infectious disease should be thoroughly injected with a reliable embalming fluid: all external orifices should be securely closed with absorbent cotton and finally the entire surface of the body, including the hair, should be thoroughly cleansed with a reliable disinfectant, such as a solution of corrosive sublimate (one in one thousand parts of water) or of carbolic acid (one in twenty parts of water).

With such precautions taken the shipment of bodies may be permissible as governed by the rules on page 125.

The importance of giving such careful attention to the remains of all who die of an infectious disease cannot be too strongly emphasized.

Often there is no wish to remove the remains at the time from the place of death to some remote point, and the burial is made without thorough disinfection of the body. At some later period, for some reason or other, the wish for removal may arise, but then it will be too late, for the remains of one who has died of a dangerous infectious disease and buried without proper disinfection immediately following death, cannot be safely disinterred.

It may be well, while dealing with this subject, to state that very few of the so-called disinfecting embalming fluids on the market will stand the bacteriological test.

It is a difficult but not impossible task to find an embalming fluid that has both good disinfecting and cosmetic qualities.

Another important fact to bear in mind in the use of embalming fluids is the necessity of thorough injection. The common tendency is to use an insufficient quantity of fluid. Enough can be injected only under pressure. Such pressure should be constant, as secured from a compressed air apparatus or the fountain syringe or irrigator, placed with its bottom at

least 6 feet above the point of insertion for the injecting canula or needle. The bulb syringe can never be a reliable instrument for use in embalming.

**5. Of Discharges from the Body.** This is quite a simple matter if the disinfector will keep in mind the fact that all of the material to be disinfected must be kept in contact with the disinfecting agent for a sufficiently long time to destroy all germs and their spores.

Disinfecting agents must be chosen with relation to their special action or power of penetration. This subject will be thoroughly treated under the special study of disinfection for individual diseases.

## CHAPTER IX.

### CONCERNING CERTAIN INFECTIOUS DISEASES.

**Anthrax.** (Malignant pustule, wool-sorters' disease, splenic fever, charbon.) This is an acute infectious disease dependent upon the presence of the bacillus anthracis. It is wide spread among animals, particularly sheep and cattle. The disease is not at all uncommon in men whose duty it is to handle wool, hair and hides from countries where anthrax is somewhat common, or who have the care of diseased animals. The infection is introduced generally through some exposed part of the body—the hands, an arm, or the face. At the seat of inoculation the part soon becomes inflamed and painful. The infection follows the course of the lymphatics. The disease pursues a rapid course, generally causing death in the course of from three to five days. Not all cases are fatal; the milder ones show only local symptoms, with a sloughing sore of variable size. Infection may also take place through the alimentary canal, the result of using infected food. Under these conditions the symptoms are those of intense poisoning. Because of its highly infectious nature one ill with anthrax should be carefully isolated. All dressings should be burned. All discharges disinfected. The patient's clothing and bed clothing should be placed at once upon removal

in a disinfecting solution, until it can be boiled or sterilized with steam. After the recovery or death of the patient the room should be thoroughly disinfected as directed after other acute infectious diseases. (See page 79.)

**Bubonic Plague.** An acute infectious disease dependent upon the presence of the bacillus pestis. The lymphatic glands are the chief organs involved, as shown by inflammation and suppuration. The disease is extremely fatal. The predisposing causes are unsanitary surroundings—namely filth, poor food, etc.

Fortunately this disease is not common in the United States.

To guard against its approach, everything should be put in the best sanitary condition possible. There should be a thorough overhauling of all filth and vice centers and an attempt made to prevent overcrowding in these districts. Rats are prominent as disseminators of the disease. The most active means should be adopted to exterminate these pests in a possible plague district.

The patient suffering from this disease should be cared for in a quarantine hospital. The healthy members of the household should be kept under observation for ten days or two weeks. The chief means of disseminating this disease is by means of soiled clothing, the discharge from the suppurating buboes, and possibly the discharges from the alimentary canal. It is very important therefore that all discharges

should be promptly and thoroughly disinfected and that all soiled clothing should be placed at once in a five per cent. solution of carbolic acid until such time as they may be subjected to a thorough boiling or steaming.

With proper precautions and thorough cleanliness it is quite possible for medical attendants and nurses to avoid contracting the disease. Infection frequently takes place through abrasions of the skin. Care should therefore be taken to protect wounds or scratches from all infectious material. The hands of the nurse should be carefully disinfected each time after having been in contact with the patient or his clothing.

If a patient recovers he should be kept in quarantine at least a month. The remains of one dead of plague should be wrapped in a sheet saturated with a one to one thousand solution of corrosive sublimate, and cremated or buried at once. If buried it should be in a wicker coffin which should be well covered with quicklime. There should be no attempt at disinfecting or embalming the remains. The funeral must be strictly limited with no viewing of the remains. The shipping of the remains of one dead of plague is prohibited.

After the removal of a plague patient the disinfection of the room should be most thorough, as outlined on page 79. As a rule no attempt should be made to save bedding or clothing unless at a hospital equipped

with a modern disinfecting plant. All such articles should be burned.

**Cerebro Spinal Meningitis—Epidemic.** There is much for us to learn yet concerning this disease. This much we do know. It does occur in epidemic form. It is sometimes at least due to the presence of a specific organism the diplococcus intracellularis meningitidis of Wieckselbaum. It may be due to the presence of bacteria which cause other infectious disease such as the pneumococcus, the bacillus diphtheriæ, etc. With this knowledge of the so-called epidemic cerebro spinal meningitis it behooves us to take the same precautions in dealing with it that we would in dealing with typhoid fever, bearing in mind the additional need of disinfecting all discharges from the nose and throat. There need be no restriction upon the funeral of one having died of epidemic cerebro spinal meningitis provided the remains have been properly prepared for burial.

**Cholera.** The so-called Asiatic cholera is a specific disease due to the presence of the comma bacillus. It involves chiefly the intestinal and the respiratory passages. The comma bacillus leaves the body in the stools and urine and possibly in the vomitus. It is very important, therefore, that all dejecta from a cholera patient should be thoroughly disinfected during the course of the disease and for some time after recovery, should this occur. Here, as in the case of typhoid fever, the best disinfectant for the

stools and urine is milk of lime (see page 15), in which they should be kept for at least half an hour before they are finally thrown into the vault or sewer.

Those who have to nurse a cholera patient cannot be too careful. The body of the patient should be kept scrupulously clean. The hands of the nurse must be thoroughly disinfected after each handling of the patient. The personal and bed clothing of the patient when soiled, must be removed and placed in a disinfecting solution at once, where it should be kept until it may be further disinfected by boiling or steaming after the usual methods.

The comma bacillus enters the system with contaminated drinking water or food, or from uncleanly hands or utensils. A suspicious water that has to be used for drinking or bathing purposes, or in preparing food for use should be stirilized by boiling. The disease is very fatal. Fortunately it is not common in this country. After recovery or death from cholera the methods of disinfection of the room where the patient has been and of everything which had been used about the patient should be most thorough, regardless of cost. See page 79 and following.

While it is undoubtedly possible to disinfect the remains of the dead from cholera, santitarians and the public at large are not willing to take even the most remote chance of infection. Transportation of the remains of those who have died of cholera is therefore

prohibited. (See page 125.) Cremation of the remains of such patients should be insisted upon.

**Diphtheria.** This is a specific disease, depending the presence of the bacillus diphtheriæ, also known as the Klebs-Löffler bacillus. This disease belongs with tuberculosis in its methods of infection rather than with smallpox, scarlatina, etc. The parts generally involved are those of the respiratory tract, including the nose. If all secretions are promptly and thoroughly destroyed as they escape from the mouth and nose, so long as the presence of the bacillus diphtheriæ is demonstrated by bacteriological findings, there should be little danger of this disease being transmitted to others. It must be borne in mind, however, that the disappearance of the diphtheritic membrane is not sufficient evidence to prove the disappearance of the specific germs of the disease. These may continue to be present for weeks after the nose and throat are apparently well. It is very seldom that the infected secretions are all destroyed as they escape from the person infected, partly because the necessity for so doing is not fully appreciated, partly because of the constant attendance necessary on the part of the nurse to accomplish such; partly because of the difficulty attending such constant action during the entire danger period. Because of failure to destroy all infected secretions the person, clothing and bedding of the patient become contaminated, as do also the furniture, walls, etc., of the room or rooms where the pa-

tient is, and also the clothing and person of the nurse or other individual who is brought in contact with the diphtheritic patient. It must be apparent, therefore, that thorough isolation and thorough cleanliness during the progress of diphtheria, with thorough disinfection after the recovery from the same, is absolutely necessary if further infection is to be prevented. Because of the difficulties already mentioned in caring for all diphtheritic discharges, it is not possible to care properly for diphtheritic patients at their homes unless there is a room in which both patient and nurse can be absolutely isolated during the entire infectious period of the disease. A common danger from diphtheria is the promiscuous use of drinking cups or dishes for food, of pencils, books, chewing gum, etc., that have been smeared with the bacillus diphtheriæ.

Those who have been exposed to diphtheria should be given an immunizing dose of antitoxine. Exposed individuals should be excluded from school so long as they are residing in a quarantined house—and even when released from a quarantined house unless shown bacteriologically to be free from the bacillus diphtheria.

Disinfection for diphtheria requires, therefore, the prompt collection, preferably upon pieces of old but clean muslin, of all secretions from the mouth and nose of a diphtheritic patient, with its immediate immersion in a disinfecting solution, or immediate destruction by fire. During convalescence, when there is but slight discharge from nose and throat, a respir-

ator containing absorbent cotton saturated with an antiseptic solution of carbolic acid, or some equally efficient agent, should be worn over the mouth and nose until the entire disappearance of the bacillus diphtheriæ is demonstrated bacteriologically.

Final disinfection of a diphtheritic patient and the nurse consists in the use of a complete bath for both, with an entire change of clothing. All clothing used during the progress of the disease, if of a washable nature, should be immersed upon removal in an antiseptic solution, preferably of carbolic acid (one part in twenty of water) until such time as it might conveniently be further cleansed by boiling and laundering after the usual methods. All non-washable personal or bed clothing should be burned or thoroughly disinfected with formaldehyde. Disinfection of a room and its contents after the removal of a diphtheritic patient requires, first, the use of a general gaseous disinfectant of which formaldehyde is undoubtedly the best, followed by special disinfection of infected articles, and a thorough cleansing of the furniture, woodwork and floors of the room with a solution of corrosive sublimate (one in one thousand parts of water) or carbolic acid (one in twenty parts of water) or other equally efficient agent. Finally, the walls should be freshly papered, painted or kalsomined, and the woodwork freshly varnished, oiled or painted. (See page 79 and following.)

Disinfection of the remains of one who has died

of diphtheria should be carried out as directed on page 87, with especial attention given to the mouth and nose. These should be injected with a ten per cent solution of formaldehyde and then sealed with dry absorbent cotton. The remains should then be injected with a reliable disinfecting fluid. With such precautions conscientiously carried out, there should be no further danger from infection from such remains.

**Dysentery.** From the latest reports upon this disease it seems probable that it is always due to infection, but that all forms of dysentery are not due to the same cause. It is wise to group it with typhoid fever as regards its care in every way. The nurse should take the same personal precautions. The same cleansing of the patient; the same disinfection of clothing and of the stools. The same care of the dead should be carried out as directed under typhoid fever. (See page 121.) There need be no restriction upon the funeral of one having died of dysentery if the body has been properly prepared for burial.

**Erysipelas.** This is a specific disease dependent as a rule upon the presence of streptococci. The infection is found upon all surfaces or tissues involved by the disease and also in secretions and discharges from such surfaces. Erysipelas is transmissible by direct inoculation, by infection from soiled clothing or individuals and also through the air. It is found in epidemic form chiefly in hospitals. The quarantine

and care of a patient ill with erysipelas should be as complete as that directed for scarlet fever in every particular. The method of final disinfection after recovery or death of a case of erysipelas should in every way conform with that directed for scarlet fever. (See page 106.) The care of one dead of erysipelas should be most carefully looked after, for the danger of infection, both to those handling the remains and others who may be exposed is great. The rules laid down for the dead from scarlet fever are applicable for the care of this disease also. There must be no public viewing of the remains.

**Glanders.** (Farcy.) This is an acute infectious disease affecting horses, mules, donkeys, etc., and transmissible to human beings. The bacillus mallei is the specific cause.

The parts involved in horses are the nasal mucous membrane and the lymphatic glands. In man the disease may occur as an acute or chronic form—the former being the more common and being due to direct infection into wounds or abrasions of the skin. The lymphatic system is quickly involved and the patient generally dies within two or three weeks. This disease is becoming widespread among horses. Men who handle glandered horses are liable to infection. The disease may be passed from man to man. It is very important that all glandered horses should be destroyed. It is also very important that the disease if occurring in man should be promptly recognized. As

the disease is spread by direct infection it is necessary that all discharges from glandered surfaces should be promptly disinfected. Local cleanliness for the diseased part as well as general watchfulness is the important factor in the nursing of such patients.

There is much less danger in handling the remains of one who has died from glanders than from many other of the infectious diseases, with the disease once recognized. There is no reason why with the liberal use of disinfectants locally and the proper embalming of the body it should not be so prepared as to be transported any distance without danger to any one. Those who have to handle the remains of patients who have died of glanders must be exceedingly careful not to infect themselves through the accidental scratch of an instrument or through an old abrasion. The dead body should be wrapped in a sheet saturated with a one to one thousand solution of corrosive sublimate and cremated if possible; otherwise it should be buried in a wicker casket if possible. There should be a liberal mixture of quick lime with the earth thrown over the casket in its final resting place.

**Influenza,** (La Grippe.) A specific infectious disease depending upon the presence of the bacillus influenzæ. The parts involved are the respiratory tract and the alimentary canal.

The disease generally prevails as an epidemic. With our present knowledge it is impossible to control it.

During an epidemic of influenza, it is well for those who are liable to be affected dangerously by this disease to absent themselves from public gatherings and public conveyances—in fact, to avoid those places where persons suffering from the disease are apt to be found.

**Leprosy.** This is a specific infectious disease depending upon the presence of the bacillus leprae. There is an historic dread of this disease and the unfortunates who suffer from it are generally shunned after the manner described in the Bible. The danger is, however, from direct infection only and even this exists to quite a limited degree. It is advisable that lepers should be isolated, but it is not necessary that their lives should be made unendurable by a process of persecution and the constant shouting of "unclean" by those who see them. Leprosy is not nearly so dangerous as is tuberculosis, typhoid fever, syphilis, etc.

The leprous patient should have individual articles for himself—bed, bedding, clothing, towels, dishes, everything. All clothing soiled with leprous discharge should be disinfected first in a solution of carbolic acid or corrosive sublimate and later by boiling. All bandages and dressings from leprous sores should be burned.

The embalmer who has to care for the remains of a leprous patient should see that there is thorough disinfection of the body, and a thorough embalming carried out with a reliable fluid. There need

be no restrictions upon the funeral of one who has died of leprosy nor upon the transportation of the remains, provided proper precautions in embalming and preparing for burial or transportation have been taken.

**Measles.** This is a disease depending upon a specific infection, the nature of which has not yet been established. The infectious element is from the surface of the body, from the secretions of the respiratory tract—bronchial, pharyngeal and nasal —and probably from other secretions. The possibility of infection often begins with the first appearance of the disease—in fact before the disease is recognized—and continues so long as there is any desquamation from the mucous surfaces involved or from the skin. It and certain other infectious diseases are placed in a special class and designated as contagious.

It is a disease difficult to control, and one quite apt to reach everyone at some period of life. It is generally looked upon as a harmless disease. This is not altogether true. The sequelæ of measles belong chiefly to diseases of the respiratory tract—pneumonia, pulmonary tuberculosis, etc., and many a death attributed to one or the other of these causes should in fact be charged against the primary cause—measles.

It is probably better to recognize the general prevalence of this disease and to place the public on its

guard as to the dangers from complications than to try to control it by the use of disinfectants, for our present knowledge of the use of disinfectants will have little influence upon it.

Of course, when the disease is recognized, the infected individual should be placed in quarantine, but as a rule much exposure has occurred before quarantine is established.

The remains of those dead from measles should be thoroughly cleansed and embalmed, and every step taken to prevent the spread of disease through this source. It is the surface of the body, the mouth, nose and respiratory tract, that require especial disinfection.

**Pneumonia.** This is often if not always an acute infectious disease. It is not difficult to control the infectious material—the expectoration. The same precautions should be taken with this disease as in the care of tuberculosis. There need be no restrictions upon the funeral of one having died of pneumonia provided the remains have been properly prepared for burial.

**Rabies.** (Hydrophobia.) This is a specific infectious disease transmissible from one individual to another, whether among mankind or the higher animals. The nature of the infection is not yet determined. It is found in the nervous tissue, in the saliva and in certain other secretions such as the milk, the pancreatic secretions, etc., of rabid animals. It is important that

an early diagnosis should be made of this disease when its presence is suspected.

When caring for a patient ill with rabies one should be careful not to allow any of the infected saliva to come in contact with an abraded surface or sore or cut upon the attendants. After the recovery or death of a rabid patient the clothing, bedding, furniture and room where the patient was ill cannot be too carefully disinfected. The plan directed on page 79 should be carried out. In caring for the remains of one dead from rabies it is necessary to thoroughly disinfect the entire surface of the body giving especial attention to all discharges from the mouth or nose. With such precautions there need be no further restrictions and a public funeral may be allowed.

In a case of suspected rabies among animals do not kill the suspected animal, but if possible secure it alive and without injury. Confine it in a safe, quiet, roomy and comfortable place. Secure and keep under observation (i. e. quarantine) all animals known to have been bitten. Keep the supposedly rabid animal under the observation of a competent veterinarian for at least ten days. (If the animal does not die within eight days from the onset of symptoms, the disease is not rabies.) If the animal dies or has to be killed for any reason before or during confinement, care should be taken not to injure the brain or spinal cord. The disease may or may not have been rabies, but an accurate diagnosis may

usually be made at the laboratory if the following directions are observed:

Cut off the head and several inches of the neck of the animal.

Do not permit any antiseptic to come in contact with the specimen.

Place the head in a piece of new oil cloth, or water-proof material; gather up the corners and edges of this water-proof covering so as to form an improvised bag and tie tightly so as to prevent all possibility of the escape of fluids. Place the whole in a water-tight box or tin vessel. If in freezing weather, freeze the head and keep it frozen, if possible, until it can reach the laboratory or until it is placed in the express car. If it cannot be frozen, pack the water-tight box in a large quantity of ice and dry sawdust in a second box. If it is impossible to freeze the head or to secure ice for packing, the brain and upper portion of the spinal cord should be removed in as aseptic a manner (without the use of an antiseptic) as possible, and placed at once in pure glycerine in a clean sterile glass vessel. Ship by express the head, or brain and cord, prepared as directed above, to a competent bacteriologist at once.

**Scarlet Fever.** Known also as scarlatina and scarlet rash.

This is a disease dependent upon a specific poison, the nature of which is not yet determined. Infection may take place from the secretions of the mouth.

throat or nose, possibly from other secretions. Also from contact with the surface of the body or exfoliations from the same. The danger of infection is constant from the first appearance of the disease until the process of desquamation (or peeling) is completed. This may last as long as six weeks. The last of the desquamation is usually from the hands and feet.

The scarlet fever patient should be most thoroughly cared for in order to prevent general infection. Isolation must be complete, either in a quarantine hospital or in a room that is separated from the rest of the house as directed for acute infectious diseases on page 64. The disease is easily conveyed from the patient or clothing, or by books, letters, etc.

The removal of anything from the room of a scarlet fever patient, during the period of quarantine, should be absolutely prohibited, unless thoroughly disinfected at the time. Clothing from the patient, nurse, or beds should be placed in a disinfecting solution of carbolic acid (five per cent) until such time as they may be further disinfected by boiling. Dishes upon which food has been served should also be placed in a similar disinfecting solution if they are to be taken from the quarantined room. Those who have been exposed to scarlet fever should be kept under observation for about ten days or two weeks. Pupils or teachers who have been exposed to scarlet fever or who are living in a house where a patient has been suffering from scarlet fever should be excluded from

school. The periods of greatest danger for transmitting the disease to others is from the second to the fifth day of the disease, and again when desquamation is most active, usually from the thirteenth to the twenty-first day of the disease. Scarlet fever is a much dreaded disease and yet there are many outbreaks in which the mortality is less than that of measles with its sequelæ.

If death occurs the surface of the body should be thoroughly disinfected, using a five per cent solution of carbolic acid or a ten per cent solution of formaldehyde. The body orifices should be closed. There should be thorough embalming of the body with a reliable embalming fluid, and further precautions as directed under rule 2, page 125. A specially designed enveloping sheet may be used with the layer of cotton instead of the bandage as directed in the rule just referred to.

Under no conditions should there be any public viewing of the body or public funeral.

**Sepsis.** (Blood poisoning.) This is a condition dependent upon the presence of pyogenic (or pus producing) bacteria, the most severe case being generally due to the streptococcus pyogenes. There may be all degrees of infection from a mild local disturbance to a general infection which may cause death within a very few hours. Under the head of septic infection may be included the usual infection during a post-mortem examination, surgical infection, puerperal fever, pyaemia and septicaemia. All of these condi-

tions are less common now than in the past. They are evidences of filth. Antisepsis and asepsis in surgery and obstetric practice are largely responsible for this change for the better. It is a fact, however, that infection of wounds received during post-mortem examinations, or the necessary care of the dead, are exceedingly common. It behooves all who have to do with the dead to exercise the greatest care to avoid the introduction of septic material into an unprotected cut or raw surface. Disinfection during the care of or after the recovery or death of a patient suffering from sepsis should be quite similar to that outlined on page 79 and following. One cannot be too careful. It is quite possible to have the infection transmitted through the air as well as by direct inoculation. The exterior of the remains of those dead of sepsis should be thoroughly disinfected. There should also be careful embalming of the remains as for diseases governed by shipping rule. (See page 125.) There need be no restrictions upon the funeral of one having died of sepsis if the body has been carefully prepared for burial.

**Smallpox.** A disease dependent upon a specific poison, the nature of which is not yet determined. Infection may take place from the secretions of the respiratory tract, and possibly from other secretions. Also, from contact with the surface of the body or exfoliations from the same. The danger of infection is constant from the first appearence of the disease

until the process of desquamation (or peeling) is completed. This may continue until at least two months have passed since the first appearance of the disease. The last of the desquamation is usually from the hands and feet.

Smallpox patients should be thoroughly isolated in a special quarantine hospital. Such hospital should be of simple, cheap construction, in some isolated place remote from the public highway or residence property. Its furnishings should be plain, simple and cheap, in order that they may be completely destroyed by burning when the time for their disinfection comes. Connected with such hospital should be at least two well trained and responsible nurses, and an outside attendant, or "go-between" to look after the supplies, etc., for the hospital. It is wise to have two outside attendants, one to serve during the day, and the other during the night. They should act as guards as well as attendants, and should be given police authority. There must be no direct communication between the quarantine hospital and the outside world. The outside attendants should see to it that all the wants of the patients and nurses are supplied. The passage of anything from the hospital to the outside world—letters, notes, books, papers, clothing, etc.—must be absolutely forbidden.

All food must be prepared and dishes and clothing washed by the nurses or other quarantined attendants. A pit should be dug near the quarantine hospital and

all refuse, excreta, etc., should be thrown into it. Lime sufficient to cover such deposits should be thrown into the pit each time that anything is emptied therein from the hospital, and this covered with earth. Should the hospital have connection with a sewerage system, then everything disposed of in this way should be thoroughly disinfected with carbolic acid or lime. For the stools, milk of lime is the best disinfectant. For the disinfection of dishes, clothing etc., see page 65.

Smallpox patients should be frequently and freely bathed with warm water. This gives comfort, hastens desquamation and diminishes the danger to others by controlling to some extent the products of desquamation. The corrosive sublimate bath has become quite an important agent in the treatment of smallpox (one part in two thousand of water).

The body should be annointed with some non-irritating application after each bath during the entire course of the disease.

This, as well as the bath, tends to make the patient more comfortable, and also reduces the danger of infecting others, by keeping under control the desquamated material.

The patient, after having thoroughly recovered, should be given a final and complete bath and dressed in entirely fresh clothing throughout. All clothing that has been worn by a smallpox patient should be burned. All individuals who have been associated

with a smallpox patient for any time whatsoever must be placed in isolation until they have had a full bath and complete change of clothing. Susceptible persons (i. e., persons who have not recently been vaccinated) must be kept under observation until the period of incubation for smallpox has passed (two, or, better, three, weeks). They should also be vaccinated without any delay. If people who have been exposed to smallpox are not fixed in residence, and of such a character as to be depended upon to aid in every way the suppression of the disease, they should be placed in quarantine, but not, of course, with smallpox patients. They should be kept in houses of detention. When smallpox occurs in a neighborhood, there should be general vaccination of everybody, for we have in this one of the most absolute preventives known to medical science.

Of course, all pupils and teachers who have been exposed to smallpox, or who are living in a house where a patient has been suffering from smallpox, should be excluded from school for at least three weeks from the date of the last possible infection.

Physicians must be very careful not to convey this disease from patients upon whom they are attending to other individuals. In many cases it may be necessary for a special physician to go into quarantine while attending smallpox patients.

Disinfection after smallpox should be carried out as after other acute infectious diseases, see page 79.

In case of death from smallpox the remains should be placed in a hermetically sealed casket and cremated if possible. Otherwise they should be enveloped in a sheet saturated with a one to one thousand solution of corrosive sublimate and buried as quickly as possible. Burial should be so performed as to secure as speedy dissolution as possible, a basket casket by preference with a fair amount of lime sprinkled over it with the covering of earth.

The embalmer should waste no time in trying to disinfect or embalm the body. He should take particular pains to protect himself with suit or gown and the liberal use of disinfectants after having finished his duties with the remains.

Of course there must be no public funeral or viewing of the remains. There must be no disinterment of those who have died of smallpox.

**Syphilis.** This is an infectious disease depending upon a specific cause, the nature of which is not yet determined. In many of its characteristics it has a close relationship to tuberculosis. A syphylitic is a far more dangerous individual than is a leper. The transmission of infection from one person to another is easily brought about and is constantly occurring from the permiscuous use of food and drinking utensils; of towels and wash dishes; of clothing; of innumerable means of exchange. A syphilitic should be isolated more rigidly than a leper, but he is not. Possibly because the number of syphilitics is so great that

it would place too great a burden upon the non-syphilitics to take care of them. Syphilis is not only an avoidable infectious disease, but it is an unlawful disease, and yet less is done to control syphilis, by methods of isolation or quarantine, than with any of the other infectious diseases. We ostracize the leper; we legislate for sanatoria for the tuberculous; we quarantine the diphtheritic, but the syphilitic lives with us, eats and drinks with us, spreads disease far and wide among the innocent and no one says nay to him. Those who have the care of syphilitic patients cannot be too careful in looking after and disinfecting all soiled clothing and in burning all soiled dressings. Those who have the care of the remains of one dead from or having suffered with syphilis cannot be too careful. A prick from an infected needle or instrument; the smearing of an abrasion or wound with infectious material may be followed by an almost incurable infection.

The process of embalming the remains of a syphilitic must be thorough. The surface of the body must be disinfected and so completely enveloped in absorbent cotton as to insure the safety of those who may have charge of the remains while in transit.

**Tetanus.** (Lockjaw.) This is an acute, infectious disease, depending upon the presence of the bacillus tetani. This bacillus is quite generally found in the upper layers of the earth. It is quite usually present in the soil of gardens fertilized with animal manure. The

disease is introduced into the system through wounds or abrasions. With the knowledge of the most common habitat of this bacillus in the soil it is quite easy for us to understand why wounds of the soles of the feet and the palms of the hands are most likely to be infected with this bacillus, for the feet and hands are most liable to come in contact with infected soil. The discharges and dressings from the wounds of a tetanus patient contain the specific bacillus of this disease.

There is little danger of this disease being conveyed from one person to another, for it is a simple matter to destroy all infectious material in the discharges and the dressings by burning. A moist dressing should be used for a wound infected with tetanus.

The embalmer should not lose sight of the dangers from this disease, for he is liable to find soiled dressings upon the remains of one dead of tetanus. He should be extremely careful, should he remove such dressings to protect himself and to destroy the dressings at once. He should also be careful to re-dress the infected surface in such a way that there will be no danger from future infection. With the infected surface well disinfected and covered with dry absorbent cotton, together with proper embalming of the remains there should be no danger from the shipment of same.

There is always danger of infection from escaping discharges from the remains of those dead of tetanus

where not properly embalmed. The danger is particularly great for those handling the coffin during its transportation by rail or otherwise.

**Tuberculosis.** A specific disease depending upon the presence of the bacillus tuberculosis.

This disease has not been classed by the public at large as one from which there is much danger from direct infection and yet careful observation has demonstrated that this is the most common method of its transmission from one individual to another.

The nurse of a tuberculous patient; relatives who are closely associated with tuberculous patients; travelers who have tuberculous dry sputum thrust upon them in sleeping cars and other public vehicles; all of us at all times are liable to infection with tuberculosis.

Tuberculosis kills more people than any other single known disease. It kills more people than many other diseases combined. Danger is present in the dead as well as in the living tuberculous individual. Yet the bacillus tuberculosis, which seems to be omnipresent, is easily destroyed, and illness or death due to its presence should be practically nil. This bacillus generally, if not always, leaves the body in a moist state. So long as it remains moist it is not readily conveyed from individual to individual, except by direct contact. It is important, therefore, that while in this moist condition it should be destroyed. This can readily be done by the proper use of disinfectants. The types of tubercular disease most readily trans-

mitted are those involving the respiratory and the intestinal tracts. All discharges from either of these sources in a tuberculous patient should be destroyed. Sputum should be collected upon paper handkerchiefs to be burned while still moist, or in spit cups or cuspidors containing a disinfecting fluid. Until the habit of promiscuous spitting is entirely abolished the danger from tuberculous sputum will continue, for it quickly dries where it is deposited and the germs that it contains may then be carried far and wide, contaminating the air we breathe.

Tuberculosis may be conveyed from the sick to the well through the sputum deposited upon drinking cups or other utensils used for the conveyance of food or drink to the mouth. This danger can be avoided by insisting that tuberculous patients shall not use dishes or cups that are for general use. The use of public drinking cups at schools and other public places cannot be too strongly condemned.

The disinfecting fluids suitable for use in spit cups, cuspidors, etc., are corrosive sublimate (one in one thousand parts of water) or carbolic acid (one in twenty parts of water) or other equally efficient agents. The use of drugs with a disagreeable or pronounced odor should be avoided.

Next to the sputum and secretions from the mouth and nose, the intestinal discharges and the urine are the most common carriers of the bacillus tuberculosis. It is important that these waste products should be

destroyed. Urine is easily disinfected by mixing it with a disinfecting solution such as those of corrosive sublimate or carbolic acid, etc., but how seldom is this precaution taken. The intestinal discharges, unless in a liquid state, are not easily disinfected.

This is especially true when certain drugs which combine with albumin to form insoluble albuminates upon the surface of the stools, such as corrosive sublimate, are used.

Probably the best disinfectant for tuberculous urine or stools is "milk of lime," (see page 17) which should be freshly prepared every day or two. There should be an exposure of at least half an hour before the infectious material is finally thrown into a vault or sewer.

Disinfection of the personal clothing and bedclothing of a tuberculous patient is important, for these articles readily become soiled and dried, and are then sources of danger in the house, and especially in public places, such as hotels, sleeping cars, etc. A tuberculous patient should always sleep alone, both as to bed and room.

Personal cleanliness of a tuberculous individual is extremely important. This is especially true of those in the advanced stages of the disease and applies particularly to tuberculous men with beards. As a matter of fact a tuberculous man should have a smooth shaven face, but the beard, because it masks emacia-

tion, is even more apt to be worn by the tuberculous than the non-tuberculous man.

The room of a tuberculous patient should be especially chosen and properly cared for. It should be plain in character, without draperies or carpets. A painted or whitewashed wall is preferable. The furniture should be plain and without upholstering. It may be necessary to have one or more chairs and a couch made comfortable with cushions, etc. These should be covered with washable goods in order that they may be frequently cleaned, or with cheap goods so that they may be destroyed without much loss. The bedclothing should all be of washable material.

Such a room and furnishings need not seem cheerless if a little tact and ingenuity is used. In addition to precautions in the choice of furnishings for the invalid's room, an occasional thorough disinfection with formaldehyde or by wiping all parts of the walls, woodwork and furniture with a cloth moistened with some disinfectant is desirable.

After the removal of a tuberculous patient from a room, it and its contents should be as thoroughly disinfected as it would have been, had the former occupant been ill with smallpox.

Tuberculous children should be excluded from public schools, and the tuberculous inmates of public institutes, hospitals, asylums, prisons, etc., should be kept by themselves and cared for as infectious individuals.

Disinfection of the remains of a tuberculous individual is very important. The surface of the body should be thoroughly cleansed with a ten per cent solution of formaldehyde or corrosive sublimate (one part in one thousand parts of water) or carbolic acid (one part in twenty parts of water) or other equally efficient disinfectant.

The cavities of the body should be filled with a reliable disinfecting embalming fluid, giving special attention to the lungs and the intestinal tract.

All orifices should be closed with dry absorbent cotton. This course of action is imperative, for the remains of the tuberculous dead are often shipped long distances, and leakage of any non-disinfected secretions or body fluids would be a source of danger to all those who might come in contact with the box containing the remains while in transit or at its final destination. A scratch or abrasion upon any part of the body may receive sufficient infection from the fluids escaping from a leaky casket containing the remains of one dead of tuberculosis to cause the death of the person thus inoculated.

**Typhoid Fever.** This is a specific disease dependent upon the presence of the bacillus typhosus. It is one of the most difficult and widespread of the infectious diseases that we have to deal with. As a rule the typhoid bacillus enters the system with food or drink, infected drinking water being the most common cause of the disease. Infection may enter the system

from the hands of an individual, soiled with typhoid dejecta, or from infected water used in bathing, or from the dust of a room infected with dried typhoid dejecta, or from food that has become contaminated from washing with infected water, or from infected flies.

The bacillus typhosus leaves the person of the typhoid patient in the stools and urine. The stools of a patient having recently recovered from typhoid fever may in a comparatively short time be free from these disease germs. The urine, on the other hand, may continue to be infectious for a long time after the recovery of a typhoid fever patient.

It is very important that the stools and urine of a typhoid fever patient should be thoroughly disinfected during the progress of the disease and for some time after the apparent recovery. Probably the best disinfectant for such use is the "milk of lime" (see page 17) which should be freshly prepared each day. Of this milk of lime a ten per cent solution should be mixed thoroughly with the stools and allowed to stand for at least half an hour before being finally thrown into a vault or sewer. Those who have to nurse typhoid fever should see that the body of the patient is kept scrupulously clean and also that their own hands are disinfected after each handling of the patient. The personal and bed clothing of the patient

should be carefully watched, and if soiled should be removed and placed in a disinfecting solution until such time as it may be further cleansed by boiling and washing after the usual methods.

If proper care has been taken of a typhoid fever patient during the progress of the disease, there will be little necessity for disinfection of the room where the patient was confined. Only the ordinary methods of cleaning up are called for.

The remains of those who have died of typhoid fever should always be thoroughly embalmed with a disinfecting fluid, whether they are to be buried at once or shipped to some other point. By so doing the danger of infecting drinking water draining from the grave would be diminished.

Any fluid that might escape from the casket while in transit of one who had died of typhoid fever might easily convey the disease to those having to handle the same unless thorough embalming had been practiced. The external orifices of one having died of typhoid fever should be closed with dry, absorbent cotton.

**Typhus fever.** (Jail fever. Ship fever.) An acute infectious disease of which the cause is as yet unknown.

It is a filth disease and, as certain of its names indicate, is apt to occur when people are crowded together with unsanitary surroundings and poor food. The disease occasionally reaches some of the seaport towns of the United States and may even exist in epi-

demic form, but this is extremely rare now and will become more and more so, for proper inspection and quarantine of all suspects arriving upon our shores, together with the employment of good sanitary methods and good food at the immigrant landing stations will do much to prevent its general spread even should an occasional case be landed.

The care of a typhus fever patient demands as much attention as that of yellow fever, cholera, etc. It is said to be peculiarly liable of tranmission from the patient to the nurses and physicians in attendance. The remains of those dead from typhus fever are to be wrapped in a disinfecting sheet as directed for small-pox, etc., and cremated or buried at once. Transportation of the remains of those dying of typhus fever is not permitted.

Disinfection after typhus fever should be carried out as directed on page 79 and following.

**Yellow Fever.** An acute infectious disease depending possibly upon the presence of a bacillus. It is a disease confined chiefly to the gulf coast of the Southern States, Mexico and South America, the Atlantic coast of South America to Monte Video and the West India Islands.

Fortunately this disease is not often seen north of Washington. The recent study of yellow fever by Dr. Walter Reed, U. S. A., will probably have a marked influence in changing our present methods of quarantine and disinfection for this disease.

## CHAPTER X.

### QUARANTINE.

This term was orginally applied to the period (forty days) that a vessel known or suspected of having on board the germs of some malignant infectious disease was obliged to stay in seclusion and under strict surveillance upon its arrival in a non-infected port. The term is now used to apply to the enforced isolation of individuals or objects in or coming from a place where a dangerous communicable disease is presumably or actually present.

The time limit for quarantine depends upon (1) the object quarantined (2) the nature of the disease quarantined.

In the house quarantine against infectious diseases, the diseased individual, susceptible individuals and the contents of the room or house are affected. The diseased individual is quarantined so long as any danger of the infection from which he suffers continues. The susceptible individual is quarantined until the period of incubation for the disease quarantined against has passed. Of course, should the disease appear in such susceptible individual, he is then transferred to the class of diseased individuals. A house or room, with its contents, is kept quarantined until such

time as the diseased or susceptible individual is no longer a resident source of infection. When such a time arrives the place can be properly disinfected and again be a suitable place of residence for non-infected individuals.

The time of quarantine for each infectious disease is governed by (a) the period that must elapse before the possible appearance of the disease; (b) the duration of the disease.

# APPENDIX.

## RULES FOR THE TRANSPORTATION OF THE DEAD.

Adopted by the American Association of Baggage Agents and approved by the Conference of State and Provincial Boards of Health and the National Funeral Directors' Association, and in force in many states:

Rule 1. The transportation of bodies dead of small-pox, Asiatic Cholera, Yellow fever, Typhus fever or Bubonic plague, is absolutely forbidden.

Rule 2. The bodies of those who have died of diphtheria (membraneous croup), scarlet fever (scarletina, scarlet rash), glanders, anthrax, or leprosy, shall not be accepted for transportation unless prepared for shipment by being thoroughly disinfected by (a) arterial and cavity injection with an approved disinfectant fluid, (b) disinfecting and stopping of all orifices with absorbent cotton, and (c) washing the body with the disinfectant, all of which must be done by an embalmer holding a certificate as such, approved by the State Board of Health. After being disinfected as above, such body shall be enveloped in a layer of cotton not less than one inch thick, completely wrapped in a sheet and bandaged and encased in an air-tight zinc, tin, copper or lead lined coffin, or iron casket, all joints and seams hermetically sealed, and all enclosed in a strong tight wooden box. Or, the body being prepared for shipment by disinfecting and wrapping as above, may be placed in a strong coffin or casket, and said coffin or casket encased in an air-tight zinc, copper or tin case, all joints and seams her-

metically sealed and all enclosed in a strong outside wooden box.

Rule 3. The bodies of those dead of typhoid fever, puerperal fever, erysipelas, tuberculosis and measles, or other dangerous communicable diseases other than those specified in Rules 1 and 2, may be received for transportation when prepared for shipment by filling cavities with an approved disinfectant, washing the exterior of the body with the same, stopping all orifices with absorbent cotton, and enveloping the entire body with a layer of cotton not less than one inch thick, and all wrapped in a sheet and bandaged and encased in an air-tight coffin or casket, provided, that this shall apply only to bodies which can reach their destination within forty-eight hours from time of death. In all other cases such bodies shall be prepared for transportation in conformity with Rule 2. But when the body has been prepared for shipment by being thoroughly disinfected by an embalmer holding a certificate, as in Rule 2, the air-tight sealing and bandaging with cotton may be dispensed with.

Rule 4. The bodies of those dead of diseases that are not contagious, infectious or communicable, may be received for transportation when encased in a sound coffin or casket and enclosed in a strong outside wooden box, provided, they reach their destination within thirty hours from time of death. If the body cannot reach its destination within thirty hours from time of death, it must be prepared for shipment by filling cavities with an approved disinfectant, washing the exterior of the body with the same, stopping all orifices with absorbent cotton and enveloping the entire body with a layer of cotton not less than one inch thick and all wrapped in a sheet and bandaged, and encased in an air-tight coffin or casket. But when

the body has been prepared for shipment by being thoroughly disinfected by an embalmer holding a certificate, as in Rule 2, the air-tight sealing and bandaging with cotton may be dispensed with.

Rule 5. In cases of contagious, infectious or communicable diseases, the body must not be accompanied by persons or articles which have been exposed to the infection of the disease, unless certified by the Health Officer as having been properly disinfected. Before selling passage tickets agents should carefully examine the transit permit and note the name of the passenger in charge, and of any others proposing to accompany the body, and see that all necessary precautions have been taken to prevent the spread of disease. The transit permit in such cases shall specifically state who is authorized by the Health Authorities to accompany the remains. In all cases where bodies are forwarded under Rule 2, notice must be sent by telegraph to the Health Officer at destination, advising the date and train on which the body may be expected. This notice must be sent by or in the name of the Health Officer at the initial point, and is to enable the Health Officer at destination to take all necessary precautions at that point.

Rule 6. Every dead body must be accompanied by a person in charge, who must be provided with a passage ticket and also present a full first-class ticket marked "Corpse," for the transportation of the body, and a transit permit showing physician's or coroner's certificate, health officer's permit for removal, undertaker's certificate, name of deceased, date and hour of death; age, place of death, cause of death, whether communicable or non-communicable, the point to which the body is to be shipped, and when death is caused by any of the diseases specified in Rule 2, the

names of those authorized by the Health Authorities to accompany the body. The transit permit must be made in duplicate, and the signatures of the physician or coroner, health officer and undertaker must be on both the original and duplicate copies. The undertaker's certificate and paster of the original shall be detached from the transit point and securely fastened on the coffin box. The physician's certificate and transit permit shall be handed to the passenger in charge of the corpse. The whole duplicate copy shall be sent to the official in charge of the baggage department of the initial line, and by him to the Secretary of State or Provincial Board of Health of the State or Province from which said shipment was made.

Rule 7. When dead bodies are shipped by express, the transit permit must be made in triplicate, and the signature of the physician or coroner, health officer and undertaker, must be on all three permits. Of these transit permits, one copy shall be securely fastened upon the outside of the box, one copy shall be forwarded by the express agent to the party to whom the body is shipped, and one copy shall be forwarded by the express agent to the Secretary of the State or Provincial Board of Health of the State or Province from which said shipment was made.

Rule 8. Every disinterred body, dead from any disease or cause, shall be treated as infectious or dangerous to the public health and shall not be accepted for transportation unless said removal has been approved by the state or provincial health authorities having jurisdiction where such body is disinterred, and the consent of the health authorities of the locality to which the corpse is consigned has first been obtained; and all such disinterred remains shall be enclosed in a hermetically sealed (soldered) zinc, tin or

copper lined coffin or box. Bodies deposited in receiving vaults shall be treated and considered the same as buried bodies.

## FORMULAE FOR EMBALMING FLUID.*

*Formalin Fluid.*

R

| | |
|---|---|
| Formalin (40% formaldehyde) | 1 pint. |
| Carbolic acid (95%) | 1 pint. |
| Glycerine | 4 pints. |
| Sodium chloride | 4 pounds. |
| Water enough to make | 5 gallons. |

*Arsenic Fluid.*

R

| | |
|---|---|
| Alcohol | 2 pints. |
| Carbolic acid (95%) | 1 pint. |
| Glycerine | 4 pints. |
| Arsenite of soda | 3 pounds. |
| Water enough to make | 5 gallons. |

* Furnished by Dr. C. A. Erdmann, Professor of Anatomy, University of Minnesota.

# Index.

# INDEX.

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