bly due to the latter cause that noises in which, as a rule, high resonating overtones exist, are more exactly localized than simple notes. In the studies on the monaural localization of sound made by Angell and Fite, it was found that the judgment of direction was very accurate in persons depending on one ear only, and depended largely on the quality of the sound coming from different directions. It is possible that certain muscular and tactile sensations should also be here included. Ed. Weber conjectured that the tympanum felt its own vibrations. It better accords with the results of other experiments, however, to consider that the action of the tensor tympani muscle, by its involuntary accommodation to sounds of different intensities, thus accompanies auditory impressions with muscle sensations of varying strengths. In cases of auditory hyperæsthesia, affecting one ear alone, errors of judgment may arise, owing to the fact that a sound coming from the side *opposite* to the hyperæsthesia may nevertheless cause a so much stronger sensation that the patient completely misjudges its direction.

LIGHT.—Sight is the sense through which the chief judgments of direction are made. In all cases the direction of an object is represented by a line joining the body with the object, and objects on that line or its continuation are considered to have identical directions. The phenomena are first to be considered for one eye alone, the field of vision being stationary. When the image falls on a part of the retina other than the fovea, the eye must be turned in order to bring the image on that point, and for this purpose it must be moved by its muscles. In performing such a muscular movement there are at least two sensations which may be recognized: the innervation feeling and the tension of the muscles. When the eyeball is pulled to one side by the hand, objects in the field of vision appear to move, and the eye to remain quiet; at the same time, pulling the eye changes the tension of the muscles; nevertheless, neither the movement of the eye by a means other than the contraction of its own muscles, nor the tension of the muscles due to the same cause is recognized as a motion of the eye, and so objects appear to move in a direction opposite to that in which the eye is pulled.

In patients having the musculi recti paralyzed, an attempt to contract a rectus is followed by an apparent motion of objects in a direction opposite to that in which it is willed to move the eye. In this case there is present neither the contraction of the muscle nor any result of the exertion, but merely the innervation feeling; yet, from this arises a subjective sensation of motion. Since the innervation feeling can produce this result, it is argued that our judgment of the direction of an object seen is based on the remembrance of the innervation feeling necessary to bring the eye into such a position that the image shall fall on the fovea.

The only result of the innervation impulse which we plainly recognize in the eye is the altered position of objects in the field of vision. This alteration, bringing with it a variation in the position of the image, can be shown to act as a control on innervation efforts.

If a prism be put before the eye so as to cause the rays from a given object to fall on a new part of the retina—the object, for example, having thus been apparently moved to the left—and then, the eyes being closed, if the hand is stretched in the supposed direction, it will fail to touch the object, passing by it to the left. On touching the object, however, with the eyes open, and associating thus the new position of the image with fresh tactile sensations, a new combination is developed by which it can be inferred from the position of the retinal image where the hand must be placed to touch the object.

When two eyes are used the conditions are somewhat complicated, for one eye influences the judgments derived from the other. Helmholtz gives the following illustration: When one eye is closed, both axes being kept parallel, and first a distant then a very near object is fixated, both having identical directions, no change occurs in their apparent position in the field so long as the eye is simply focussed from one to the other. If, however, the near object be fixated and the closed eye be now converged so as to occupy the position necessary to fixate it if it were open, a marked apparent motion takes place in the distant object in such a way that, if we consider the left eye as the one open during the experiment, the distant object moves from right to left. On again making the axes parallel, it resumes its former position. The sense of direction, as derived from one eye, must accordingly be considered modifiable by the other eye, even though the latter remains closed. In an analogous way the judgment of horizontal and vertical lines is found to be influenced by the motions of the closed eye. For instance, with the axes parallel, one eye being closed, a thread forming the diameter of a short circular tube, when judged to be vertical or horizontal, is found to be really so, though by putting the head in different positions during the experiment the retinal horizon of the observing eye may, in certain of these positions, make an angle of even ten degrees with the true horizon. When, however, the previously parallel axes are converged, and the individual fixates a point on the thread, the line which was previously horizontal is now seen to undergo apparent rotation of such a nature that it corresponds with the rotation of the retinal horizon of the closed eye. Suppose in this case the right eye to be open, then on converging the left (closed) eye the right end of the thread apparently sinks while the left rises. The position of the eyeballs is found to be in part under the reflex control of impulses from the semicircular canals, and for this reason all judgments modified by the position of the eyeballs tend to be also modified by changes in the position of the head.

In the section on judgment of direction Helmholtz treats of a number of cases in which the objects viewed are in motion, for example, falling water. One who has watched a waterfall for a time notices, on looking at the bank, that objects there appear to move in a direction opposite to that of the water. The explanation offered by Helmholtz is that the eye, in order to view the falling water, continued to follow it downward for a time, then twitched up only again to follow it down, and so on. On now directing the gaze to the bank, the objects there apparently move in the opposite direction because the observer is unconsciously still continuing the same movements of the eyes as when gazing at the waterfall, and because this motion is unconscious the objects on the bank are consequently judged to move. The objection to this explanation of these illusions of motion is that they can be obtained in the after-image with the eyes closed, and, further, that two opposite motions can be simultaneously produced in the same retina. These facts, which with others were brought out by Bowditch and Hall, conclusively show that the explanation of Helmholtz will not apply in these cases. No other explanation of the phenomena is, however, at present formulated.

In considering the centre to which these lines of direction are referred, E. Hering drew attention to the fact that we perceive the direction of objects seen as if both eyes were fused into one, and that one was located in the median plane of the head. This cyclopean eye is considered as so constructed that the retinal images are projected outward in the line of vision of that eye.

The habit of thus attending only to the mean direction of the lines of sight is considered by Helmholtz to depend on the fact that the median vertical plane of the body is the one to which all objects are referred, so that an object neither right nor left lies in that plane, which also passes midway between the two eyes. Further, an object may lie to the right or left of this plane and bear the reverse relation to the vertical plane (parallel to the median vertical plane) of the homonymous eye. In practice, we thus fuse the directions of both the optic axes and refer the lines of sight to a point in the head midway between the two eyes. That this process results from habit is indicated by the fact that variations occur in the location of the cyclopean eye, and that fixation of the attention on the impressions from one eye alone serves to

make that for the time being the reference point. Other observations indicate the same conclusion.

The above statements are mainly from Helmholtz's "Physiologische Optik," where they are elaborated.

Henry Herbert Donaldson.

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DISEASE, FATALITY OF.—(Ratio of Deaths to Cases.) The question is often asked, Out of a given number of cases, how many die? The answer to this question is derived from the observations of physicians in active practice, both in hospitals and in private practice. The fatality in hospitals, as a general rule, is usually greater than that of private practice, since the milder cases are not usually sent to hospital for treatment.

The enactment of laws requiring the notification of infectious diseases has enabled the health officers of cities to contribute a considerable amount of information upon this subject, so far as the fatality of the principal infectious diseases is concerned.

The following figures are the results of observations collected from six States (Connecticut, Massachusetts, Michigan, Indiana, Rhode Island, and Vermont), and from nineteen of the principal cities in the United States, during the five years, 1894–98.

In these States and cities there were reported to the sanitary authorities 619,765 cases of smallpox, typhoid fever, scarlet fever, diphtheria, and measles in the period mentioned, and there were in the same States and cities 75,715 registered deaths from the same causes during the same time.

These cases and deaths were distributed as follows:

Diseases.	Reported cases.	Registered deaths.	Fatality, per cent.
Smallpox	9,222	2,385	25.8
Typhoid fever	69,758	13,284	19.0
Diphtheria and croup	195,783	44,411	22.7
Scarlet fever	127,847	9,211	7.2
Measles	217,755	6,424	2.8

In the compilation of these figures it was found necessary to reject the returns of several entire States and cities, in consequence of manifest deficiency in the number of reported cases.

The use of antitoxin for the treatment of diphtheria became general in the early months of 1895 throughout the country. If, therefore, the returns for the year 1894 be treated separately it appears that there were 25,844 reported cases, and 7,654 deaths in that year, the fatality being 29.6 per cent., while the fatality of the remaining years was only 21.6 per cent.

Treating the year 1898 in the same manner, the fatality was only 20.5 per cent., or the ratio of 31,494 cases to 6,471 deaths. In two States and seven cities combined, having a total population of 4,250,000, the fatality from diphtheria in 1894 was 29.7, and in the same places in 1898 it was only 14.6, confirming the statement that the diphtheria fatality has been cut in twain since the general introduction of antitoxin treatment. It is also quite noteworthy that in several large cities, situated a thousand miles apart, the diphtheria fatality before 1895 was quite uniformly from 29 to 30 per cent.*

The following figures are the result of observation in England during the eight years, 1891–98, under the operation of the English Notification Act. The diseases quoted are smallpox, scarlet fever, diphtheria and croup (considered together), typhus fever, typhoid fever, and erysipelas. The number of reported cases of these was 974,907, and the deaths from the same causes were 89,864:

* "Public Hygiene and State Medicine in the United States," a monograph contributed to the Paris Exposition of 1900, p. 22.

FATALITY OF CERTAIN DISEASES IN ENGLAND (1891–1898).*

Diseases.	Reported cases.	Registered deaths.	Fatality, per cent.
Smallpox	27,613	2,639	9.6
Scarlet fever	538,828	23,034	4.3
Diphtheria and croup	167,452	37,304	22.3
Typhus fever	2,441	522	21.4
Typhoid fever	126,967	22,208	17.5
Erysipelas	111,606	4,157	3.7

* Compiled from the reports of the Local Government Board of England for the years 1891–1898 inclusive.

The fatality in different years varied for the different diseases as follows (1891 being excepted, as notification was at that time comparatively incomplete): Smallpox, a maximum of 17.2 per cent. in 1896, and a minimum of 6.8 per cent. in 1895; scarlet fever, a maximum of 4.8 per cent. in 1894, and a minimum of 3.7 per cent. in 1898; diphtheria and croup, a maximum of 25.1 per cent. in 1894, and a minimum of 18.6 per cent. in 1898; typhus fever, a maximum of 26.9 per cent. in 1893, and a minimum of 19.5 per cent. in 1895; typhoid fever, a maximum of 17.8 per cent. in 1892, and a minimum of 16.8 per cent. in 1898; erysipelas, a maximum of 4.7 per cent. in 1892, and a minimum of 3.1 per cent. in 1898.

The fatality of smallpox showed a wide variation in different years, the variation being undoubtedly dependent upon the relative protection afforded by vaccination in the community attacked. In some parts of England vaccination has been neglected to a much greater degree than in others. (For the comparative fatality of smallpox in the vaccinated and unvaccinated, see *Vaccination* in a later volume.)

The fatality of diphtheria in recent years appears to have undergone decided modification under the use of antitoxin, as already shown.

If the figures for the four years, 1891–94, previous to the introduction of antitoxin in England, are compared with those of the four years, 1895–98, succeeding the introduction, a marked decrease is shown, the fatality of the previous period having been 24.3 per cent., while those of the latter period were 20.8 per cent. The fatality in the last year of record, 1899, had fallen to 17.3 per cent.

In Massachusetts where free distribution of antitoxin has been made throughout the entire State since March, 1895, the fatality for diphtheria had fallen from 28.3 per cent. in the four years (1891–94) to 14.9 per cent. in the succeeding six years (1895–1900) and to 10.2 per cent. for 1900.

Observations in the same State also show that the fatality among those who were treated with antitoxin was 11.2 per cent., or 657 deaths out of 5,888 cases. The number treated was much larger than this, but this number 5,888 represents those in relation to whom returns were made to the State Board of Health by attending physicians. This includes cases in private practice and in hospitals.*

The probability that any one will die when attacked with a given disease differs very much in degree with the character of the disease. For example, compare the fatality of chickenpox with that of smallpox, or that of hydrophobia or of tetanus with that of measles or mumps.

Fatality differs also with age and to some degree with sex. It also is modified by artificial conditions introduced for the purpose of limiting its severity, such as vaccination and the use of antitoxin.

The general degree of resistance to the fatal result from all causes is greatest at about eleven or twelve years of age.

Samuel W. Abbott.

DISINFECTANTS.—Littré, in his "Dictionary of the French Language," defines disinfectants as follows: "*Désinfectants*, substances qui détruisent chimiquement les mauvaises odeurs." This is the popular sense in which

* "Thirty-first Annual Report of State Board of Health of Massachusetts," 1899, p. 667.

the word is used in this country and in Europe. Vallin, in his "Traité des Désinfectants et de la Désinfection," says that it is impossible to accept this definition, for the reason that it is not sufficiently comprehensive. He says: "We may say with reason that every bad odor renders disinfection necessary, but it does not follow that disinfection is useless when there is no emanation appreciable to the sense of smell" (*loc. cit.*, p. 3). After discussing the subject at some length, Vallin gives the following definition as that preferred by him: "Disinfectants are substances capable of neutralizing morbific principles, virus, germs, miasms, or of decomposing the fetid particles and gases which are disengaged by organic matter undergoing putrefaction" (*loc. cit.*, p. 6). On another page (2) Vallin admits that it is, perhaps, unscientific "to introduce into the idea of disinfection the suppression of odors which offend the sense of smell"; for, he says, "the bad odor is not injurious in itself; it is an epiphenomenon which does not necessarily give the measure of the injurious properties of the air, or of any substance whatever." Nevertheless the popular sense in which the word is used is included in his definition, because, as he says, "it is necessary to avoid doing violence to the ordinary sense of words" (p. 2).

When the ordinary sense in which a word is used leads to confusion, we think it better to insist upon its being used in a more limited and scientific sense, and to instruct the public as to the exact meaning which we would attach to it. We, therefore, prefer the definition which has been given by the Committee on Disinfectants of the American Public Health Association: "The Committee would define a disinfectant as an agent capable of destroying the infective power of infectious material." This does not commit us to any theory as to the exact nature of the agent which gives to infectious material its infecting power, but it draws a line between the morbific agents which produce that class of diseases known as infectious —which it is the object of disinfectants to destroy—and other substances which may injuriously affect man, such as the gases of putrefaction and other toxic agents. From our point of view we do not disinfect a privy vault by destroying the sulphureted hydrogen given off from its contents, any more than we would disinfect the atmosphere of a laboratory by neutralizing the fumes of chlorine or of sulphur dioxide given off during an experiment. To make our position entirely clear we cannot do better than to quote further from the "Preliminary Report of the Committee on Disinfectants":

"The object of *disinfection* is to prevent the extension of infectious diseases by destroying the specific infectious material which gives rise to them. This is accomplished by the use of *disinfectants*.

"There can be no partial disinfection of such material; either its infecting power is destroyed or it is not. In the latter case there is a failure to disinfect. Nor can there be any disinfection in the absence of infectious material.

"Popularly, the term disinfection is used in a much broader sense. Any chemical agent which destroys or masks bad odors, or which arrests putrefactive decomposition, is spoken of as a disinfectant. And in the absence of any infectious disease it is common to speak of disinfecting a foul cesspool, or bad-smelling stable, or privy vault.

"This popular use of the term has led to much misapprehension, and the agents which have been found to destroy bad odors—*deodorizers*—or to arrest putrefactive decomposition—*antiseptics*—have been confidently recommended and extensively used for the destruction of disease germs in the excreta of patients with cholera, typhoid fever, etc.

"The injurious consequences which are likely to result from such misapprehension and misuse of the word disinfectant will be appreciated when it is known that:

"Recent researches have demonstrated that many of the agents which have been found useful as deodorizers, or as antiseptics, are entirely without value for the destruction of disease germs."

If it were demonstrated that every kind of infectious material owes its specific infecting power to the presence of known micro-organisms, we might bring this article to a close by referring the reader to the title *Germicides*, under which a full account will be found of the present state of knowledge with reference to the germicide power of the chemical agents known as disinfectants, as determined by biological tests.

But this is not yet demonstrated, and our knowledge relating to the comparative value of disinfectants is to a considerable extent empirical, being based upon the practical experience of sanitarians. This experience, however, is not in conflict with the view that the infectious agent in those diseases which have not been proved to be germ diseases—smallpox, yellow fever, scarlet fever, etc.—is in truth a living organism. On the other hand, the disinfectants which, independently of theory, have gained the confidence of sanitarians, are for the most part potent germicides, *e.g.*, chlorine, sulphur dioxid, etc.; or they are at least antiseptics of greater or less value, *e.g.*, the metallic chlorids and sulphates.

The same is true as regards the disinfectants which have been tested experimentally upon various kinds of infectious material, such as vaccine virus, anthrax blood, septicæmic blood, etc., without reference to the nature of the infectious agent contained in the material disinfected, the test of disinfection being made by inoculation into susceptible animals. The writer, in 1881, made an extended series of experiments of this kind, in which the blood of a rabbit just dead from an infectious form of septicæmia was the material to be disinfected. The comparative value, as disinfectants, of the agents tested corresponded, in general, with the germicide power of the same agents as subsequently determined in another series of experiments (1883). In the last-mentioned experiments the destruction of the test organisms in culture solutions was demonstrated by the failure of these organisms to grow in a suitable medium after having been exposed for a given time to the action of the germicide agent in a certain proportion. As the infectious character of the septicæmic blood in the first series of experiments had been demonstrated to be due to the presence of a micrococcus, this correspondence in the results obtained by the two methods was, *a priori*, to have been expected.

In the experiments which have been made upon vaccine virus, results have also been obtained which, in the main, correspond with the germicide value of the agents tested, as established by the biological method. As we have no direct evidence that in this case disinfection consists in the destruction of germs, a brief account of these experiments, and of others made directly upon different kinds of virus, will be given in the present article. For the experimental data relating to the germicidal power of various chemical agents, the reader is referred to the article under the title *Germicides*.

Heat.—As long ago as 1831, Dr. Henry, of Manchester, tested the action of dry heat upon vaccine virus, and found that the virus no longer produced any result upon inoculation when it had been exposed to a temperature of 60° C. (140° F.) for four hours. In similar experiments made by Baxter (1875), in which the time of exposure was reduced to twenty-five minutes, it was found that a temperature of 90° to 95° C. (194° to 203° F.) was required to insure complete destruction of infecting power of virus dried upon ivory points. The virulence of *fresh* vaccine virus is destroyed at a considerably lower temperature. In a report made to the Congress of Amsterdam in 1879, Carsten and Coert, as the result of a large number of experiments, arrived at the conclusion that "animal vaccine heated to 64.5° C. (148.1° F.) for thirty minutes loses its virulence."

Sulphur Dioxid.—The power of sulphurous acid gas to destroy the virulence of vaccine virus has been demonstrated by several experimenters. Ten minutes' exposure in an atmosphere "saturated with sulphurous vapor" was found, both by Dougall and by Baxter, to neutralize the virulence of vaccine dried upon ivory points (Vallin). In these experiments the exact amount

of sulphur dioxid in the air of the disinfection chamber is not stated. Experiments made by the writer in 1878 showed that *liquid* vaccine is rendered inactive by exposure for four hours to sulphur dioxid in the proportion of five volumes per one thousand of air. In experiments with dried virus upon ivory points, made in 1880, it was found that virulence was destroyed by six hours' exposure in an atmosphere containing one per cent. of this gas.

Baxter and Vallin have tested the disinfecting power of sulphur dioxid upon the virus of glanders. The first-named experimenter found that four parts to one thousand by weight, in solution, destroyed the virulence of material obtained from nodules (rubbed up in water) from the lung of an animal with glanders. Vallin experimented with virulent pus from an abscess, obtained from a patient with glanders in the hospital of Val de Grace. This pus was proved, by inoculations into guinea-pigs and other animals, to produce the characteristic lesions of glanders. Some of this pus placed in a watch glass was exposed for twelve hours to sulphur dioxid, generated by burning 2 gm. of sulphur in a box having a capacity of 100 litres (= 14 volumes of SO_2 to 1,000 volumes of air). Disinfection was complete, as proved by inoculation.

Chlorine.—Experiments made by Dougall, and by Baxter, upon liquid vaccine show that to insure the disinfection of this material, chlorine must be absorbed in sufficient quantity to give the liquid virus an acid reaction. Baxter found that 0.14 of one per cent. was insufficient, while the presence of 0.163 per cent. of chlorine in the lymph neutralized its virulence. In experiments with dried vaccine upon ivory points, Baxter found that exposure for thirty minutes in an atmosphere "saturated with chlorine" was necessary in order to accomplish disinfection. In experiments made by the writer in 1880, it was found that the virulence of dried virus upon ivory points was destroyed by exposure for six hours in an atmosphere containing one volume per cent. of chlorine gas.

Carbolic Acid.—The power of carbolic acid to destroy the virulence of vaccine virus has been established by the experiments of Braidwood and Vacher, of Baxter, and of Hoppe-Seyler. But to accomplish this result, the pure acid must be mixed with the lymph in a proportion of two per cent., and a certain time must be allowed for its disinfecting action. Both Hoppe-Seyler and Baxter found that two per cent. destroys the virulence of liquid vaccine, while one per cent. fails to do so. On the other hand, in Braidwood and Vacher's experiments 2.5 per cent. failed when vaccination was practised *immediately* after mixing the disinfectant with the liquid virus.

Baxter has also experimented upon the virus of glanders, and found that two per cent. was successful in destroying its infecting power, while 0.5 per cent. failed to act as a disinfectant (Smart). In the writer's experiments (1881), with the blood of septicæmic rabbits, infective virulence was destroyed by 1.25 per cent., while 0.5 per cent. failed.

It is impossible in an article of this character to give a complete account of the experimental evidence on record relating to the comparative value of disinfectants. But a careful consideration of this evidence, as obtained in practice by sanitarians, and in laboratory experiments made directly upon infectious material (test by inoculation), or upon pure cultures of various micro-organisms (test by cultivation), shows that many agents commonly used are quite unreliable, as used, and that for practical purposes the agents which can be safely recommended as disinfectants are few in number.

The following list embraces those which we believe to be the most generally useful and available for disinfecting purposes: Dry and moist heat; formaldehyd, sulphur dioxid; the hypochlorites of lime and of soda (chlorid of lime, and Labarraque's solution); caustic lime, mercuric chlorid; cupric sulphate; carbolic acid.

We shall briefly indicate the special purposes for which one or the other of the agents named seems best adapted.

Disinfection of Excreta, etc.—Success in restricting the extension of infectious diseases will depend largely upon the proper use of disinfectants in the sick-room. For the disinfection of excreta the most available chemical agents are: 1. *Chlorid of lime.* Dissolve in water, in the proportion of four ounces to the gallon of water (Standard Solution No. 1 of the Committee on Disinfectants of the A. P. H. A.); use one quart of this solution for the disinfection of each liquid discharge in cholera or in typhoid fever. For solid fæcal matter a stronger solution or a larger quantity will be required, and it will be prudent to use a larger quantity of the standard solution recommended for a very copious liquid discharge. 2. *Carbolic acid*, a five-per-cent. solution to be used in quantity at least equal to the amount of material to be disinfected. 3. *Caustic lime*, in the form of freshly prepared milk of lime—this should contain about one part by weight of hydrate of lime mixed with eight parts of water. To be used in amount equal to that of the excreta to be disinfected. 4. *Cupric* sulphate, a four-per-cent. solution.

Disinfection of the Person.—The hands of those who wait upon persons sick with infectious diseases should be washed in an aqueous solution of mercuric chlorid of the strength of 1 to 1,000; or of carbolic acid, 1 to 50; or of chlorid of lime, 1 to 100; or of Labarraque's solution, 1 to 10. The same solutions may be used for washing soiled surfaces upon the body of the patient, and for instruments and utensils which have been exposed in the sick-room.

For a complete bath, carbolic acid, 1 to 100; mercuric chlorid, 1 to 5,000; or Labarraque's solution, 1 to 20, may be used. The dead should be wrapped in a sheet saturated with a solution of mercuric chlorid of 1 to 500; or of carbolic acid, 1 to 20; or of chlorid of lime, 1 to 25.

Disinfection of Clothing.—"Boiling for half an hour will destroy the vitality of all known disease germs, and there is no better way of disinfecting clothing which can be washed than to put it through the ordinary operations of the laundry" (Prelim. Rep. of Com. on Disinfectants). Clothing may be disinfected by immersion for two hours in a solution of mercuric chlorid of the strength of 1 to 1,000; or of cupric sulphate, 1 to 100; or of carbolic acid, 1 to 50; or of chlorid of lime, 1 to 100 (the bleaching properties of chlorid of lime must be remembered). Clothing which would be injured by washing or immersion in a disinfecting solution may be disinfected by steam, by formaldehyd, by sulphur fumigation, or by dry heat, in a properly constructed "oven." In the absence of spores, a temperature of 230° F., maintained for three hours, will be sufficient. The clothing must be freely exposed, for the penetrating power of dry heat is very slight. The spores of bacilli require a temperature of 284° F., maintained for three hours, for their complete destruction. This temperature injures woollen fabrics (Koch).

Fumigation with sulphur dioxid has been largely relied upon for the disinfection of clothing. To be effectual, the articles to be disinfected must be freely exposed to its action, in a well-closed chamber, for a period of at least twelve hours. Burn three pounds of sulphur for each thousand cubic feet of air space in the room. Since it has been demonstrated that *formaldehyd* gas is much superior to sulphur dioxid as a germicide, this gas has to a considerable extent taken the place of SO_2 for the disinfection of clothing and other articles which would be injured by immersion in boiling water or in a disinfecting solution. But disinfection by *steam* is to be recommended whenever a suitable steam disinfecting apparatus is available. It must be remembered, however, that neither steam nor the gases above mentioned (formaldehyd, SO_2) can be relied upon to penetrate to the interior of mattresses, bundles of clothing, etc. To accomplish this it will be necessary to have a steam disinfecting chamber in which a vacuum can be produced prior to the admission of steam.

Disinfection of the Sick-Room.—"In the sick-room no disinfectant can take the place of free ventilation and cleanliness. It is an axiom in sanitary science that *it is*