The prevention of contagious diseases : a practical treatise on disinfectants, antiseptics, and other sanitary agents / by Charles A. Cameron.

THE PREVENTION

OF

CONTAGIOUS DISEASES.

A

PRACTICAL TREATISE

ON

DISINFECTANTS, ANTISEPTICS,

AND OTHER SANITARY AGENTS.

BY

CHARLES A. CAMERON, PH.D., M.D., L.K. & Q.C.P.,

Professor of Hygiene in the Royal College of Surgeons in Ireland; Professor of Chemistry in Steeven's Hospital and Medical College; Lecturer on Chemistry and Physics in the Ledwich School of Medicine; Analyst to the City of Dublin, &c., &c.

BAILLIÈRE, TINDALL, & COX,
LONDON, PARIS, AND MADRID.
FANNIN & CO.,
No. 41, GRAFTON-STREET, DUBLIN.
1871.

EDWARD PURDON, STEAM-PRESS PRINTER,
23, BACHELOR'S-WALK, DUBLIN.

CONTENTS.

DISEASE PREVENTION.

CHAPTER I.—ON THE NATURE OF CONTAGIOUS DISEASES.

About one-fourth of the deaths in the United Kingdom occurs from diseases termed *zymotic*, or contagious. Asiatic cholera, small-pox, scarlatina, typhus fever, whooping cough, and measles are zymotic diseases. Inflammation of the lungs, disease of the heart, and numerous other maladies, arise spontaneously in the case of each individual; whereas small-pox and similar complaints are communicated from the sick to the healthy, and by that way *alone:* hence the latter are termed "taking" or "catching" diseases.

The origin of the contagious diseases is unknown to us. Each of them probably originated in some most extraordinary combination of morbid circumstances, affecting, perhaps, but a single individual. A new zymotic disease may at any time come into existence; for some of those

which now affect us were unknown, there is good reason to believe, a thousand years ago.

Very little is known relative to the intimate nature of the contagious diseases. We know that they are communicated from individual to individual, that their propagation can be greatly controlled by human agency, and that their symptoms, like those of other complaints, are more or less amenable to medical treatment; but what it is that passes from the body of the affected into that of the healthy, and makes the latter ill, we know not. The most general and reasonable theory with regard to the nature of contagion is, that every case of zymotic disease is produced by the introduction into the body of a healthy person, of extremely minute particles, generated in, and cast out of, the bodies of the sick. These little particles are supposed by some writers to be originally of vegetable origin, whilst others regard them as excessively minute and very lowly organized animals. Each zymotic disease is produced by a different germ, or virus, or whatever the contagious principle may be. It would appear that the virus of each zymotic cannot long exist outside the human body; and it is very probable that if all the germs of a zymotic disease, let us say small-pox, now in existence, were destroyed, the malady would disappear for ever. The contagious complaint termed "scab," or "itch," is produced by the ravages of a little insect (the *Acarus scabei*), which burrows beneath the skin and multiplies therein.

This troublesome disease never originates spontaneously; for the insects which are the cause of it do not come into existence spontaneously: they are, like all other animals, derived from pre-existing forms of life of the same nature. Now, it is quite evident that if every *Acarus scabei* now living or in embryo were destroyed, there would be an end —and most likely for ever—of the itch, or scabies.

As the itch is produced by the introduction of a living being of sensible magnitude into the skin, so it is supposed that the other contagious or infectious diseases are caused by living things getting into the body. Those beings are, however, so very minute that hitherto they have not been satisfactorily examined. They are believed to possess a very simple structure, and to be in organization not superior to the bacteria, or the amœbæ amongst animals, or torulæ (yeast plants) amongst vegetables; indeed, bacteria have lately been termed microzymes, or zymotic particles.

The contagious matter enters the body in different ways. The virus of typhoid fever and the germs of Asiatic cholera are often introduced into the stomach by means of contaminated water. The poisons of small-pox and of typhus fever are wafted through the air. The contagion of scarlatina has been known to remain active for months in clothing; and many persons have caught this disease from inhabiting an apartment in which a patient had been confined several weeks previously.

To a very great extent, we are able to protect ourselves

against the attacks of contagious diseases by paying strict attention to cleanliness, ventilation, and dietetics. Abundance of fresh air should be admitted into our dwellings; the sun's rays should be allowed to freely penetrate into all the recesses of our houses; refuse animal and vegetable matter should be expeditiously removed; the sewers should be kept in good order. We should see that our supplies of water are derived from a pure source, and we should maintain our persons, clothing, and apartments in as cleanly a state as the most frequent and liberal application of soap, water, and brushes can accomplish. Every person is not equally susceptible to the influence of contagion. It is found that the intemperate are more likely to catch contagious diseases than temperate persons. Anything that lowers the vital powers predisposes persons to contract such diseases as fever, cholera, and small-pox. Unripe, or over ripe, fruit and green vegetables often induce an attack of cholera; and when that disease is epidemic, great attention should be paid to diet, and if pump or other suspicious water be used, it should first be boiled and filtered.

CHAPTER II.—ON DISINFECTANTS.

The term disinfectant includes, in the widest acceptation of the term, all the substances which prevent putrefaction, or which rapidly destroy decomposing organic matters and fœtid gases and vapours. One class of disinfectants is really composed of antiseptic substances—bodies which, like carbolic acid, almost completely prevent the decay, or decomposition of animal and vegetable substances. Most disinfectants act also by destroying low forms of animal and vegetable life and their germs; for those minute beings are believed to be concerned more or less in the decay of organic matter, and in the spread of contagious disease.

Disinfectants are valuable sanitary agents, and their use is desirable even when no contagious disease is prevalent, and notwithstanding that the strictest cleanliness is observed. When cholera or other zymotic is raging, the employment of disinfectants is imperatively required; and a few shillings spent in the purchase of these articles might often be the means of saving valuable lives.

There are an immense number of bodies to which disinfecting properties have been described, but I shall only describe those the efficiency of which has been fully proved.

Nitrous Fumes.—On dissolving copper in nitric acid a colourless gas is evolved, which, on coming into contact with the air, absorbs oxygen from the latter, and produces ruddy fumes—a variable mixture of nitrous acid and hyponitric acid. These fumes are, perhaps, the most powerful of the gaseous disinfectants, but they are so dangerous to life that they should only be used under the immediate superintendence of a scientific or medical man.

Chlorine.—By heating black oxide of manganese with about four times its weight of commercial muriatic acid, a yellowish green gas, termed chlorine, is evolved. It possesses a very powerful odour, and cannot be safely inspired, even when largely diluted with air. The gas can also be obtained by adding 5 parts of alum cake to 4 parts of bleaching powder, or chloride of lime; or, but in an impure, but equally efficacious, state, by the addition of 1 part of oil of vitriol to 3 parts of bleaching powder. A few crystals of potassic chlorate (chlorate of potash), placed in a saucerful of muriatic acid, slowly evolve chlorine.

Sulphurous Acid is prepared by burning sulphur. It is a colourless gas, and, like chlorine, cannot be breathed without injury to the lungs.

Heated Air.—Common atmospheric air, heated to a temperature of above 250 degs., is a powerful disinfecting agent.

MURIATIC ACID.—The acid liquid known in commerce by the name of spirits of salts, or muriatic acid, is water containing in solution about one-third of its weight of hydrochloric acid gas. By boiling the commercial article, the gas which it contains is, in great part, expelled, and it acts as a disinfectant of moderate power. The liquid also possesses disinfecting properties.

CONDY'S LIQUID is a solution of permanganate of potassium in water. It acts by freely parting with the large proportion of oxygen which it contains, when it comes in contact with organic matter, especially if the latter be in a decaying state. Although by no means so powerful as some other disinfectants, it possesses the great advantage of being without odour, and it is, therefore, well adapted for use in the sick room.

CARBOLIC ACID.—Pure carbolic acid is a white crystalline solid; but the commercial article is a thin, tar-like liquid, with an odour resembling that of a mixture of tar and creosote. This substance acts by reason of its great antiseptic virtues. When mixed with animal or vegetable substances, it prevents them from fermenting, or becoming putrescent; but it allows them to undergo a very slow and harmless kind of decay, or oxidation, during which process no hurtful matters are evolved. It destroys animalcules and minute plants; but in this respect it is excelled by other sanitary agents. There can be no question as to the

valuable disinfecting properties of carbolic acid, and it is to be regretted that its odour is objectionable, and that so many accidents have occurred from persons drinking it in mistake for porter and other liquids. Tar, and tar oils, possess, but in a much feebler degree, the disinfecting properties of carbolic acid; whilst picric acid and benzoic acid (a dear substance) are probably more powerful sanitary agents than carbolic acid.

Vinegar and ammonia, though used as disinfectants, are of but little value as such.

Chloride of Aluminium is a very powerful disinfectant, and it deserves to come into general use, on account of its non-poisonous nature. "Chloralum" is the term given to a commercial article containing a large proportion of chloride of aluminium, and which has lately been highly recommended by distinguished sanitarians and chemists. Mr. Wanklyn —a well-known London chemist—says of chloralum:— "For removing fœtor and effluvia, it is better and more available than any agent with which I am acquainted. In this respect it is incomparably superior to chloride of lime." Dr. John Dougal, in an elaborate paper* on "the relative powers of various substances in preventing the generation of animalculæ or the development of their germs, with special reference to the germ theory of putrefaction," states

* Read at the meeting of the British Association for the Advancement of Science, held in Edinburgh, August, 1871.

that chloride of aluminium possessed the power of retarding putridity and of preventing the appearance of animalcules to a far greater extent than any of the commonly employed disinfectants. This statement is based on the results of what appears to have been a series of very carefully conducted experiments.

Sulphate of Copper (*Bluestone*, or *Blue Vitriol*).—According to the recent experiments of Dr. Dougal, bluestone possesses germ-destroying and anti-putrefactive properties equal to those of chloride of aluminium: it differs from the latter, however, in being poisonous. Sulphate of copper instantly removes the odour of sulphuretted hydrogen.

Nitrate of Lead has been used as a disinfecting agent, but not largely. It rapidly removes the odour of sulphuretted hydrogen, and may be applied to foul sewage. This salt is poisonous.

Sulphate, Sulphite, and Chloride of Zinc are, especially the latter two, good disinfectants, particularly for sewage; but they have the disadvantage of being poisonous. "Burnett's Solution" is simply chloride of zinc dissolved in water; it may be easily prepared by dissolving pieces of zinc in muriatic acid.

Ferrous Sulphate (*Sulphate of Iron, Copperas, or Green Vitriol*) is the cheapest of the heavy metallic salts used for disinfecting purposes. It is applied to manure

heaps and sewage; but it is not a powerful sanitary agent. Ferric chloride, or perchloride of iron, has been employed rather largely as a sewage deodorant. It is prepared by dissolving rust of iron in muriatic acid.

Bichromate of Potassium (bichromate of potash) is extolled as a disinfectant by Dr. Angus Smith, a distinguished sanitarian, and still more recently by Dr. Dougal: the latter says of chromic acid (prepared by adding sulphuric acid to bichromate of potassium) that its antiseptic power is double that of carbolic acid, and that "it must ere long take the foremost place as a sanitary agent." I think, however, that chromic acid is hardly likely to become a cheap disinfectant.

"Bisulphite of Lime" has been largely used as an antiseptic, but chiefly for the preservation of meat and other kinds of food. It has been highly commended by several chemists.

"McDougall's Powder" is a compound of calcium sulphite (sulphite of lime) and carbolate of calcium (carbolate of lime). It is extensively used as a deodorant for sewage, stables, &c.

Alum, Lime, "Superphosphate of Magnesia," and other earthy bodies are, or have been, employed as disinfectants, chiefly in the case of sewage. Alum, and other salts of the earth alumina appear on the whole to yield tolerably satisfactory results as sewage deodorants.

CHARCOAL absorbs noxious gases and vapours into its pores, where they are soon rendered innocuous. Large pieces of charcoal are very useful in the sick room and other places where the air is likely to become impure. In the dairy, where the slightest taint of the air would injure the flavour of the butter, large lumps of charcoal are found to be very useful. Charcoal has been largely used for the purpose of filtering—so to speak—sewage gases; and it is extensively employed in water filters. Animal charcoal is the only kind that should be used in water filters.

CHAPTER III.—ON DISINFECTION.

HYGIENE OF THE SICK ROOM.—The atmosphere of a room in which a patient lies cannot be subjected to the influence of such disinfectants as sulphurous acid, or chlorine. Abundance of fresh air should be admitted—in fact, too much attention could hardly be paid to the ventilation of the apartment, and it should be provided with a fire-place. The larger the room is, the better for both

patient and attendants. Light should, unless under very peculiar circumstances, be freely admitted. Solution of chloralum or permanganate of potash should be placed in large saucers. The dejecta and saliva of the patient should be instantly covered with a strong solution of bluestone, chloralum, or carbolic acid ; and they should be speedily conveyed from the room. Slops of any kind ought to be promptly removed. The less furniture (consistent with comfort) the room contains the better. Window and bed curtains, carpets, and table cloths should not be tolerated. The linen which has been removed from the patient is best placed in a tub containing chloralum. In a house where there are several inmates, it is well to hang a sheet moistened with chloralum, &c., outside the door of the sick room. Instead of ordinary handkerchiefs, the patient might use rags, and these should be placed in a basin, and covered with disinfecting solution. The attendants should place themselves in such a way that the air entering the apartment would pass from them towards the patient. The less communication held between the inmates of the sick room and those of the other apartments (who are obliged to remain in the house) the better. Should the patient die, the body should be isolated, and interred as speedily as decency admits of.

Disinfection of the Empty Room.—After the removal of the patient, the room should be thoroughly cleansed, disinfected, and aired. All the furniture which admits of

it should be washed with strong chloralum solution and removed to an empty room. The apartment being completely denuded of its furniture, the process of purification may be effectively performed in the following manner :— Wash the floor and woodwork with water and (preferably carbolic acid) soap. Remove the wall paper, first washing it with solution of chloralum or other disinfecting agent, so as to protect the workmen. Close up all openings except the door ; and having generated a sufficient quantity of a powerful disinfectant, instantly retire and close the door.* After twenty-four hours the door and windows are to be thrown open, and in a few days the room is ready to be re-papered, and its ceiling whitened.

The quantity of disinfectant used should be proportionate to the size of the room. If it contain 2,000 cubic feet of space, it would require the combustion of about 27 pounds of sulphur to convert all the oxygen of the air into sulphurous acid, and even then only one-fifth of the space in the room would be occupied with sulphurous acid (fumes of burning sulphur). I do not think that less than 4 pounds of sulphur would produce sufficient fumes wherewith adequately to disinfect a room containing 2,000 cubic feet.†

* When much chlorine gas is generated the chimney should not be wholly closed.

† The cubic space is determined by multiplying the length of the room by the width, and the resulting number by the height of the room. For example 15 × 20 × 10 = 3,000.

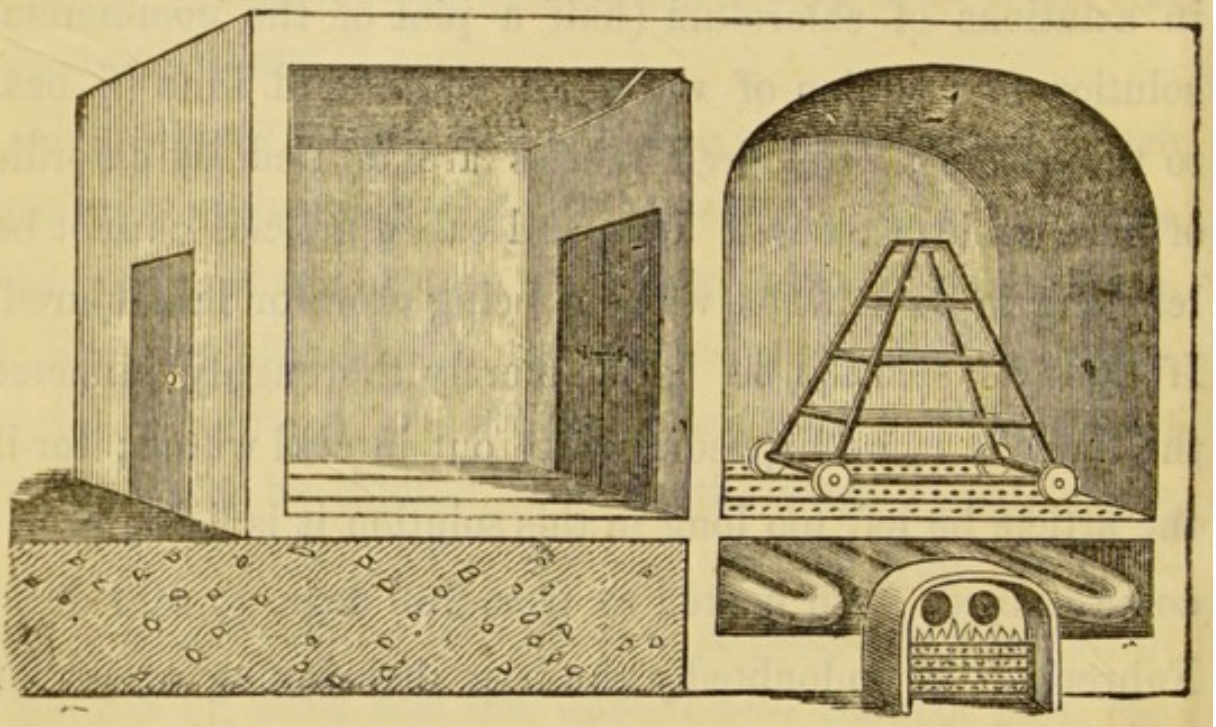
Chlorine is, in my opinion, a much more powerful disinfectant than sulphurous acid. For a room, such as that above described, it would be necessary to employ the gas evolved from a mixture of $2\frac{3}{4}$ pounds of alum cake and 3 pounds of chloride of lime, or (but mixed with hypochlorous acid) of 3 pounds of bleaching powder and 1 pound of oil of vitriol, diluted (previously) with four times its volume of water.

The sulphur is best burnt in one or more earthenware pipkins, containing a few red hot coals, and placed upon flags, slates, or over water, so as to avoid accident from fire. In liberating the chlorine the greatest care must be taken, especially when oil of vitriol is employed. The oil of vitriol should be diluted in an earthenware vessel, which is capable of withstanding the heat evolved from the mixture. The bleaching powder is best placed in a crock, or large baking dish, and the diluted acid poured into the latter. As a copious disengagement of gas of a most irritating and poisonous nature takes place the instant the acid comes into contact with the powder, the operator must effect a precipitate retreat from the room, instantly closing the door after him. Whilst working a muffler should be kept over the mouth and nose. To disinfect with nitrous fumes, mix 1 pint of commercial nitric acid with an equal quantity of water, and pour the diluted acid upon $\frac{1}{2}$ a pound of copper turnings. If copper filings be used, the disengagement of the fumes takes place very

rapidly. A room may be disinfected by means of liquids; but in such case the purifier must be applied in the form of spray, which cannot, in all cases, be readily accomplished.

DISINFECTION OF CLOTHING.—Clothes that are not injured by being washed may be disinfected by prolonged steeping in solutions of chloralum (half a pint of the commercial solution to a gallon of water) or chloride of lime (6 ozs. to the gallon). Coloured fabrics are injured by chloride of lime, and uncoloured linen and calico articles cannot be left long in its solution without being more or less injured. If Condy's solution be used, merely thoroughly immerse the linen in it, and speedily rinse out in cold water; for if the article be left too long in this solution it is liable to become stained. Air heated to from 260 degs. to 300 degs. Fahrenheit is undoubtedly the best disinfecting agent for clothing and bedding, as it does not in the slightest degree injure the articles, whilst it is as effective as the most powerful of the ordinary disinfectants. An oven cautiously heated may be employed, the articles being kept in the heated air for a couple of hours at least. The Corporation of Dublin have constructed a hot air disinfecting chamber at a cost of £400. It is situated in Marrowbone-lane, in the "Liberties," and any one may have their tainted clothing disinfected in it without any charge. It is to be regretted that the citizens of Dublin do not more frequently

avail themselves of the great advantages which this hot air chamber offers as a means of stamping out scarlatina, whooping cough, and similar diseases. If this chamber were in constant requisition, I can hardly doubt but that the mortality from zymotic diseases in Dublin would soon be sensibly diminished.*



The engraving shows the construction of the chamber. The walls and ceiling of the compartment in which the clothes are heated are built of brick, and its floor is composed of perforated iron plate. The heat is radiated into the compartment from the exterior surface of a coil of iron pipe, 80 feet long, and which acts as part of the furnace

* Anyone requiring clothing to be disinfected at the hot air chamber should write a day previously to the articles being sent to J. Dwyer, keeper of the chamber, Corporation Depot, Marrowbone-lane. The articles may be enclosed in sacking or matting, and sent in a hand or other cart.

flue. The products of the combustion which takes place in the furnace escape into the atmosphere, without previously mixing with the air contained in the close chamber; no emanations from the infected clothes can pass into the atmosphere, and, consequently, no one need feel alarmed at the close propinquity of the apparatus.

SEWAGE DISINFECTION.—Solution of chloralum, carbolic acid, or of some such metallic salt as copperas, should occasionally be poured into the sinks, and all other places leading to the sewer. The ash-pit, or midden, is benefited by the occasional sprinkling of a disinfecting liquid. If there be a cistern of water devoted exclusively to the W. C., pour into it daily a wineglassful of chloralum, or carbolic acid, solution. One pound of chloralum powder, five pounds of sulphate of iron, or one pint of carbolic acid are sufficient quantities to add to five gallons of water: if the sewers be very offensive, somewhat stronger solutions may be applied; whilst for watering streets the solution may be ten times weaker.

For manure heaps and liquid manure, chlorine and chloride of lime are very unsuitable, whilst charcoal, alum, or chloralum are suitable, applications. If the manure be quite fresh, quick-lime is a good preservative, but this substance acts unfavourably on stale manure. One pound of freshly burnt quick-lime is sufficient for 100 gallons o fresh liquid manure, and it will preserve its fertilising qualities for a long time.

CHAPTER IV.—ON VACCINATION.

One of the most fatal and loathsome diseases which afflict mankind is Small-pox, or *Variola*. Formerly this disease was very prevalent in Ireland. During the ten years ended in 1841, no fewer than 58,006 persons died from small-pox in Ireland. During the next ten years the number of deaths from this disease diminished to 38,275, and from 1851 to 1861, 12,275 fell victims to this pest. During the last ten years the deaths from small-pox steadily declined, and last year there were only two or three cases reported in the whole country.

The extinction of small-pox in Ireland is attributable to the increasing practice of vaccination amongst the people, and to the admirable manner in which the Poor Law medical officers have performed their duties as public vaccinators. Small-pox has lately been raging in England, and the disease was imported into Ireland, where, up to the present (October, 1871), it has carried off but few victims. The population is now so well protected by vaccination that the small-pox poison dies out, instead of spreading, when it is imported from England. The discovery

of the wonderful protective property of vaccination is due to the distinguished English physician, Jenner, who established the fact in the year 1796. When persons recover from small-pox, scarlatina, or any similar complaint, they enjoy, for the rest of their lives, almost complete immunity from further attacks. It is quite possible that a person who has had small-pox might again become affected with the complaint, but a second attack of the same malady is an extremely rare event. There are some diseases of the human species which have a close affinity to maladies affecting the lower animals. The disease termed cow-pock resembles human variola, and it may be easily communicated to man. What is termed inoculation (in speaking of small-pox) is the introduction beneath the skin of matter taken from a small-pox pustule. Inoculation was long employed for the purpose of producing a mild attack of small-pox; but this so-called protective measure* has now been superseded by vaccination, or the introduction of matter (lymph) from the vesicles produced in the heifer whilst affected by bovine small-pox. The disease induced by the introduction of cow-pock lymph beneath the skin of a human being is termed *vaccinia*, and it is a very mild

* Small-pox inoculation is prohibited by law, and anyone who practises it is liable to be prosecuted. It is still surreptitiously practised by ignorant quacks, by whom small-pox poison is, it is to be feared, widely spread in many countries.

one, death rarely resulting from it. When once we have had a genuine attack of vaccinia we are nearly as unlikely to die from small-pox as if we had already suffered from the latter disease.

Many persons do not believe in the protective influence of vaccination; but the evidence in its favour is too clear to be refuted. The whole body of physicians, with extremely few exceptions, are in favour of vaccination.

According to some authorities, an unvaccinated person is more than twenty times more liable to catch small-pox than a vaccinated person; and in a report of the London Small-pox and Vaccination Hospital, it is stated that vaccination reduces the mortality from small-pox from 35 per cent., or even a higher rate, to 1 per cent. I have no doubt but that the protective effects of vaccination are not so great as some writers maintain; but I believe the operation greatly lessens the chance of catching small-pox, and that, but to a far greater extent, it prevents the disease assuming a malignant type when it is contracted. When small-pox occurs in the case of a vaccinated person it is termed *post vaccinal*, or *modified small-pox*.

During the recent epidemic of small-pox in London, it was found that the mortality of small-pox patients who had not been vaccinated amounted to from 35 to 44 per cent., whilst the deaths amongst the patients who had been vaccinated varied from 4 to 9 per cent. The vaccinated patients included all who had vaccine scars, but some of

these were very slight, and the mortality amongst the vaccinated patients was almost completely confined to those who had imperfect marks.

In vaccinating, the following rules should be observed:—Vaccinate, if possible, from arm to arm; be careful not to draw blood with the lymph; make four distinct scars, or punctures when vaccinating; lymph should not be taken from those who have been re-vaccinated; healthy children, whose families are free from taint, should be selected as sources of lymph.

Medical opinion is divided on the subject of re-vaccination; but the majority of physicians believe that it is necessary. Some physicians are of opinion that re-vaccination is desirable every ten or fifteen years. My own impression is that the vaccine influence gradually declines, and that every adult should be re-vaccinated once at least. Cases of small-pox amongst re-vaccinated persons are of extremely rare occurrence. It should be observed that the symptoms of vaccinia are generally more severe when the patient is an adult.

In some parts of the Continent it is the practice to vaccinate directly from the heifer, and some English physicians have recommended this method for general adoption in these countries. Vaccinia has, however, become a human malady, and its virus loses none of its properties in passing

from individual to individual. The distinguished sanitarian, Dr. Simon, the medical officer of the Privy Council, is strongly opposed to vaccination from the heifer.

It is alleged against vaccination that it is often the means of transmitting consumption, scrofula, and other diseases; but there is little reliable evidence in support of this allegation. It would, indeed, be most foolish were we to neglect vaccination on the ground that the vaccine lymph might be a possible carrier of the virus of disease. Such an accident does not probably occur even once in a hundred thousand cases.

CHAPTER V.—ON WATER AS A CARRIER OF DISEASE.

It is a general belief amongst physicians that two contagious diseases—namely, Asiatic cholera and typhoid (*enteric*) fever are propagated by means of impure water. According to some authorities, the former disease is chiefly spread by this channel. The case of the pump in Broad-street, London, has often been quoted in support of this

belief. It was proved that the water of this pump had been rendered impure by matters ejected from the bodies of cholera patients; and it was found that an immense number of persons who drank this pump water caught cholera. I have known many cases of cholera, which I am firmly convinced were the result of the use of contaminated water.

In general, the purest drinking water is that furnished by large lakes. Glasgow is supplied with the water of Loch Katrine, which is so pure that it contains only two grains weight of solid matter in every imperial gallon (70,000 grains).

Next to lake water, that flowing in rivers is the purest. Running waters soon lose by oxidation most of their organic substances. It is surprising how soon sewerage matters become converted into innocuous mineral substances when hurried along with the waters of a rapid stream. Still, it must not be supposed that all rivers are pure; on the contrary, those that flow through densely populated districts not unfrequently are loaded with organic mpurities. When the sewage of a large town is discharged into a river, even of large size, it is evident that its waters must remain very impure for miles below the source of the contamination. This is the condition of many of the large rivers in England; and it will remain so

until the refuse matters of towns are deposited in the soil, their natural destination, and not in the water.

The river Vartry, which supplies the city of Dublin with water, is almost as pure as lake water. One imperial gallon of Vartry water contains four grains of solid matter per gallon, of which two grains are "organic and volatile," *i.e.*, driven off, or burnt when heated to redness.

Small rivers, which are not used as drains for villages or towns, are, in these countries at least, more likely to be free from dangerous impurities than the larger rivers. I know of many instances where the inhabitants of villages and detached houses could readily procure the water of bright and pure streams, and yet they prefer to use pump and well water, which are, in all probability, contaminated with the drainage from houses, stables, and farm-yards. It is quite a mistake to think that detached country houses are almost certain to be supplied with pure water; on the contrary, they are usually furnished with water pumped up out of a well sunk in or near to the farm-yard. How often do we not see the stables and manure heap placed on a much higher level than the pump, so that it would be impossible to prevent the drainage from the former finding its way into the shaft of the latter! Typhoid fever is rarely, if ever, communicated in any way other than through the medium of foul water or sewer effluvia.

Pumps furnish, on the whole, the most impure water. Some of those in Dublin yield a liquid which contains more than 200 grains of solid matter per gallon. As the water of a well consists of the drainage of a very limited area—often not exceeding a radius of two or three hundred feet—it is evident that city pumps are liable to contain animal impurities. The refuse matters thrown out of the houses, the overflow of cesspools, &c., and the leakages from imperfect sewers, sink more or less into the ground, and are carried by the drainage water into the wells. A city pump *may* yield pure water, but it is more likely to furnish a polluted supply of this indispensable liquid.

The nature of drainage water is influenced by the character of the soil through which it percolates. The springs and streams in granite, trap, porphyry, and other *primitive* rocks (those that do not contain organic remains), furnish, in general, very pure water. The millstone grit also yields pure water. The lias (variable mixtures of clay and limestone), chalk, and dolomite (magnesian limestone) springs are, in general, not so pure as those in the primitive rocks, and their water is usually very hard. The superficial wells in sandstones and heavy clays, especially when under cultivation, furnish, in general, the most impure kinds of water. It must, however, be understood that a spring, or well, in a granite rock might be loaded with dangerous organic impurities, derived from a leaking sewer. In the

case of a town built on a granite formation, the nature of the rock will not be a guarantee as to the purity of the well water. In the open country, however, we can, as a rule, form a tolerably correct opinion as to the purity of water, when we know the nature of the rocks through which it had percolated. The Vartry water, which supplies Dublin, is composed of the drainage of a granitic and mountainous district, in which there are but few people and there is very little cultivation of the soil. I should be sorry to drink the water of any city pump when I could obtain such a pure liquid as that furnished by the Vartry.

Rain water is, in general, sufficiently pure for all domestic purposes ; but it is often, when collected in towns, very impure. In the suburban districts of large towns, the rain water cistern or barrel is often placed within two or three feet of the midden or ash-pit. When refuse matter from the house is discharged into the ash-pit, a portion of it is, not unfrequently, wafted by the wind into the water-barrel. When persons suffering from contagious diseases are in a house, it is easy to imagine that dangerous emanations from their bodies might, in the way above described, find their way into the water cistern. Some time ago I examined the deposits obtained from a large number of rain water cisterns and barrels, and found in most of them traces of almost every objectionable matter usually ejected

from human dwellings. The obvious way to prevent rain water from being grossly polluted is, to keep it stored in well-covered vessels, which should be as far removed from the ash-pit and other refuse receptacles as possible. The water should be drawn off from these vessels through an iron cock, placed about six inches above the bottom; for when servants are allowed to dip their cans and jugs (with occasionally part of their, perchance, dirty arms!) into the cisterns, they are pretty certain to leave the latter uncovered. Rain water should not be stored in lead cisterns.

The flavour and colour of water are not always to be relied upon as indications of purity. Very impure water, especially in the lime and chalk formations, often are bright, sparkling, odourless, and well flavoured. Of course, when water is very brown, and possesses an unpleasant odour, it should not be used; but very often we find a yellowish water, insipid, but odourless, remarkably free from organic impurities. Water containing 8 or 10 grains of animal matter per gallon might be colourless, whilst the presence of peaty matter (which, in small quantities, is harmless), in the proportion of 2 grains per gallon, generally confers upon water a decided yellowish hue. In the absence of a chemical analysis of water, our opinion as to its qualities must, to a great extent, depend upon our information relative to its source.

It is doubtful if mere filtration is capable of removing from water the virus of cholera or typhoid fever; but it is quite certain that the germs of these maladies are destroyed by the action of boiling water. When cholera or typhoid fever is prevalent, it is the safest course to both boil and filter the water which we drink. The insipidity of boiled water may be greatly lessened by pouring the liquid from one vessel into another about twenty times.

CHAPTER VI.—SANITARY LEGISLATION.

If the provisions of the "Sanitary Act, 1866" (29 and 30 Victoria, cap. 90) were fully carried out by the local bodies who are entrusted with their execution, the condition of the public health would speedily be improved, and the spread of epidemic diseases would be lessened. This act empowers local authorities (including Boards of Guardians) to supply pure water to the people, to make sewers, and to utilize sewage. They can compel the owners of manufactories, breweries, bake-houses, &c., to abate the nui-

sance arising from the emission of black smoke from their premises. They are empowered to summons before a justice all persons on whose premises nuisances injurious to health exist. They may prosecute those who discharge impurities into potable water.

Local authorities have power to seek penalties against those who, whilst labouring under an infectious disease, enter public conveyances without acquainting the drivers or owners that they are so affected. They are empowered to remove to hospital persons ill of infectious disorders who arrive by ship, and those also who have not proper accommodation at their dwellings. They can prosecute persons (hotel keepers included) who let houses or lodgings which had been inhabited by infected persons, and which had not subsequently been properly disinfected. If persons who are suffering from infectious disease freely mix with other persons they are liable to be prosecuted. The local authorities have power, compulsory or otherwise, to disinfect premises, clothing, or bedding, and to provide vehicles for the conveyance of infected persons and things. They may supervise lodging houses, and houses let in tenements, fixing the maximum number of persons per room, and enforcing proper accommodation in reference to health, cleanliness, and decency. The officer of the local authority may inspect (if he be a medical officer or inspector of nuisances) all places where animal food, vegetables, and fruit are exposed for sale; and if any article appear to him to be unfit

for food, he has power to seize and carry it off, and to submit the case for the decision of a justice.

The Compendium of Irish Sanitary Laws, prepared by John O. Byrne, A.B., barrister-at-law, and published by W. M'Gee, Dublin, gives full information relative to all the public health acts now in force; and it contains a large number of legal decisions in sanitary cases.

CHAPTER VII.—SANITARY MEMORANDA.

DIET.—Do not fast long. Take your meals at regular hours—dining one day at 4, the next at 6, and the following day at 3 o'clock is likely to lead to indigestion. Eat slowly and masticate thoroughly. If you have lost your own teeth, get a set from the dentist's. Food and drink should not be taken when they are very hot. Breakfast soon after rising. Rest after eating, especially after dining. Late suppers interfere with sleep. If there is a second course at dinner, do not quite satisfy your hunger during the first one. Do not eat too much. Feed your children frequently and plentifully, but do not give them alcohol, tea, or coffee. Avoid unripe, or over-ripe, fruit. If you are a dyspeptic, do not eat anything that contains heated

butter, and avoid pastry. When cholera is prevalent, avoid fruit, succulent vegetables, sour drinks, and excess of spirituous beverages. Do not eat anything that disagrees with you.

CLOTHING.—Old people and children should be warmly clad, and their limbs should be well protected from the cold. Be careful not to put on damp clothes. Keep your great coat in a dry place. No shirt so healthy as a flannel one, but it should be changed as frequently as a linen one. India-rubber clothing should be worn as seldom as possible. Wear thick soled boots, with wide toes. Do not allow clothes to press tightly upon any part of the body; tight stays often cause disease, and even death.

EXERCISE.—Take plenty of out-door exercise. When beginning a long walk, set off slowly. Gradually accustom yourself to prolonged exercise, and do not continue it once a painful feeling of fatigue is experienced. Avoid *violent* exertion—it often injures the heart and other organs. Those who walk 8 or 10 miles daily rarely suffer from obesity.

BATHING.—If you bathe, see that you emerge from the water with a rosy and not a *blue* skin. Do not bathe either when you are very cold or very hot, especially the former. A bath should not be taken after a full meal, or when a feeling of hunger is experienced. Frequent ablutions of the whole body keep the skin in a healthy state.

CLEANLINESS.—Keep your house and premises as clean as possible. Do not allow the ash-pit, &c., to become too full. Dusting a room with a brush is worse than useless. Furniture should be frequently well wiped with cloths and chamois.

HEALTHY DWELLINGS.—Select a dry site for your dwelling. Let plenty of light and air enter. Every room should have ventilating openings—fifty square inches per person in the case of sleeping apartments. The sewer should not run beneath the house. Leaking sewers are a common cause of typhoid fever. Do not crowd your bedroom with furniture, and dispense with bed curtains. Green wall paper often contains arsenic. Nurseries are often overcrowded. Do not oblige your servants to sleep in damp cellars. Pools of stagnant water should not be suffered near a dwelling.

DISEASE IN THE HOUSE.—When a contagious disease breaks out in your house remove all the persons who can be spared. Do not let your children go to school, as they might convey the contagion to other children. When the illness is over, get the patient's and nurse's clothes and bedding promptly disinfected. Do not let the convalescent from scarlatina mix with other people until the skin-peeling is at an end, and several warm baths have been taken.