SECTION I.

SANITARY SCIENCE AND PREVENTIVE MEDICINE.

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The First Principles of Sanitary Work.

THE President of the Section, Dr. Alfred Carpenter, delivered the following Address:—

The subject of my discourse is Sanitary Science and Preventive Medicine; although "as old as the hills," it is, as a science, of modern growth. In no other branch of science have we so few landmarks, and so few charts upon which the rocks and quicksands are fairly laid down. In no other science are there so few recognized dicta which can be accepted as axioms or dogmas, or acknowledged as postulates upon which a more elaborate fabric may be erected. This paucity of material does not arise from its absence, but because the axioms have to be agreed to and complied with by the masses before their truth can be ascertained. The results of the applications are too often marred or rendered nugatory by the independent action of a free people; whilst, if the axioms be applied to a people who are not free, there is a similar result; for it is impossible to obtain a compliance with Sanitary law in private among those who do not know the reason why such commands are issued, however much a despotic authority may be able to control and to direct public actions. Thus it happens that Sanitary Science must be the outcome of a clearer knowledge; and its perfection can only be brought about by a judicious instruction of the people in the fundamental principles upon which, as a science, it naturally depends.

The foundation of local self-government is based upon the knowledge of the majority of the electors; and it is certain that the elected will not (except in a few instances) proceed much in advance of the intelligence of those who elect them. I hail, therefore, the opening of a Congress such as this as a step in the right direction, because its object is to interest and instruct the people in those first principles of Sanitary work which will enable the electors to choose the good and refuse the evil, with more dis-

crimination, from among those who wish to take part in the noble art of local self-government; and by that means enable them to check the consummation of some of those gigantic jobs which are sometimes carried out in the name of Sanitary Science, but which are only started for the purpose of benefiting some private individual.

The first principles of Sanitary law are so often in antagonism to private interests, so often opposed to the pecuniary advantage of the few—who are also at times themselves the mainsprings of local authority—that it is not surprising to find unsparing efforts constantly made by interested individuals to show that the first principles are wrong. These efforts may be made in good faith, one or other of the fallacies of induction which Lord Bacon describes as "idols of the understanding," blinding the judgment, and causing the opponents of right principles to delude themselves into the belief that they are public benefactors, by reason of their antagonism to the proposed change. These and other kindred causes tend to keep the science of disease-prevention on the threshold of that domain which a more perfect knowledge will accord to it, and which is only to be obtained by a generous instruction of the people in those axioms which are already established as scientific facts, and which, as such, are bases for future work. This science is destined to alter the whole field of medical practice; to render obsolete much of our present knowledge as to the natural history of disease, and the measures which are now required for its treatment. The inquiry must come as to how the incidence of disease is to be prevented, rather than, having arisen, how it is to be cured. This will apply to every kind of complaint, and will not be limited to the zymotic class. Recent observations have shown that there is not much difference, except in degree, between tuberculosis and pyæmia; and that all the class of so-called strumous or scrofulous maladies, including consumption, are as capable of prevention as is ordinary blood-poisoning. The inquiry must be made, therefore, why phthisis appears so often in our death-lists, as well as scarlatina or typhoid fever. Nearly all the diseases which are fatal to young people are amenable to prophylactic measures, and capable of diminution in their fatal effects. If these deaths can be diminished—and of this there can be no reasonable doubt—it is probable that they may be altogether prevented by a right application of knowledge; and then pneumonia, bronchitis, mesenteric disease, and other causes of death among young people, will cease to be common among us, as well

as those deaths which are produced by enthetic disease. Many of those evils which affect bony tissue, and which now give occupation to the surgeon, will then become diseases of the past. Those ailments which disfigure the human form will then be found more often in fiction than in fact among civilized people. It is a glorious field, and opens out to our view magnificent prospects. The death of the child will be the exception, and not the common end of more than half the human beings which are brought into the world. It is a serious thought that the majority of the population of the kingdom are deprived of their natural birthright, viz., "health and life," by the ignorance of Sanitary law which now prevails. When a more perfect knowledge obtains, we shall not be able, as now, to say with Pope—

> "As man, perhaps, the moment of his breath,
> Receives the lurking principle of death;
> The young disease, that must subdue at length,
> Grows with his growth and strengthens with his strength."

Disease in the young now strengthens with his strength, because we live in unnatural states, because we breathe impure air, drink foul water, use corrupt food, and disobey the laws of nature:

> "Where order in variety we see,
> And where, though all things differ, all agree."

There is no occasion for the idea expressed by Pope, that hereditary disease must run its fatal course. There is a power in the human frame to throw it off. That power is stronger in youth than the tendency to decay. It is seen in all families. Healthy children are born to unhealthy parents. There is a constant struggle in the human economy to recover its position, and remove from its tissues those matters which are unnecessary, and which are foreign to its requirements. The elements of disease are not parts of necessary tissue. If the efforts for their expulsion be made through channels which are capable of acting as exits for excreta, they will be successful, and the intruder will be expelled; but if they be made by organs whose daily perfection is necessary for the continuance of life or the performance of some endowment of the body, disease arises which may or may not end in health. If, then, we add to the troubles of the system more work for the diseased organ to do, health cannot be the outcome of the action. If we, by our social and moral customs, increase the quantity of morbid matter in the blood, we lessen the chance of health to the individual.

I have come to the conclusion that there is no truth in the theory which I once heard propounded by an eminent Sanitary authority: "That Sanitary Science was responsible for the propagation of a weakened race of beings, and was therefore tending to people the earth with a debilitated race of men." This is not the effect of Sanitary Science, but a consequence of a neglect of it. There is no occasion whatever for tissue or matter which is not required for the perfection of the human economy to be propagated for generation after generation, "growing with its growth, and strengthening with its strength," if the laws of nature be obeyed. The sequences of a disobedience to these laws are seen for three or four generations; but if the errors of the fathers be not followed by the children, there is sufficient power in the human frame to throw off the burthen, and to reclaim its birthright of good health. The gouty great-grandfather has the dyspeptic and rheumatic grandfather, the hysterical and neuralgic father, whose children throw out the mischief by some skin eruption or other evacuation; and the evil which the great-grandfather induced by his indulgence in the pleasures of the table, the bottle of port, and general laziness is lost sight of. Let his progeny do right, and obey God's laws, and, at the end of three or four generations, there will be a removal of the gouty diathesis or the tubercular constitution. An observation of several generations in numerous families is convincing me that this is a right deduction. It must be so, otherwise there could not be a single healthy person among our English people. If we follow backwards the connections of each one of us, in five generations there have been sixty-two stocks, and, in six generations, a hundred and twenty-four individuals, from each of which every person has had the chance of inheriting disease, if inheritance were a progressive law. The chance of escape would be infinitesimal, and no healthy person could be found among us at all. True, it is a common thing for diseased children to be born of diseased parents, and for these children to die of that inherited disease in their infancy. It is uncommon, even if it ever occur except from accident, for the offspring of healthy people to be diseased at their birth; whilst delicate fathers and mothers very often produce sturdy children, who grow up without a particle of disease about them.

However much, therefore, it may take the fancy of those opposed to Sanitary work to support the idea that it would be better for the human race if insanitary conditions were allowed to hold sway among us, there is no real truth in the statement. It is contrary to

our experience in nature for such a clumsy contrivance to exist, by means of which the human family would long ere this have been like the extinct monsters of former ages. We may banish the idea, then, that Sanitary work promotes the growth of a diseased race and tends to weaken the whole human family. The natural tendency of disease is either for it to destroy the blighted being, or for the diseased material to be expelled from the body. If a few generations could be brought to obey the laws which common sense and Sanitary Science have already pointed out as necessary to be observed, hereditary disease might become a thing of the past, as much as some of those maladies which used to be common among us, but are now altogether lost sight of. But hereditary tendencies are of great importance at the present time, and must be carefully studied by the student in preventive medicine. If we consult any treatise upon medical practice published in the early part of the century, we find that the most learned physicians of those days taught that diseases had various names which distinguished them from others, and which were mainly derived from the particular organ affected. Thus inflammation of the lung was described as a disease completely separated from inflammations of other organs. It was regarded as an entity in itself, which must be discovered early and treated *secundum artem*. Pneumonia was pneumonia, and nothing more. Now, however, physicians who are not routinists have discovered that pneumonia is more often the local manifestation of a general malady than a disease limited to a particular locality. The physician now tries to find out whether the disease has a zymotic or malarious origin, in which case he knows that it is only the point at which the fever is more active in its effect than at other parts of the body. If not zymotic, it may be gouty in its character. He has then to inquire whether that gout has been inherited, or has been obtained by the manner in which the patient has been accustomed to live. Or he may find that it is tubercular in its origin, or due to infection from pyæmia or septicæmia. It may be syphilitic in its character, or be due to a malignant diathesis. These particular observations are of much more importance than the mere fact of there being local disease. They are tending to reduce to very moderate dimensions the classes of disease which affect the human frame. The registration of deaths in its present form is of no scientific value; and, except the inference which may be drawn from the total number of deaths as compared with those which are produced by zymotic causes, is useless for scientific purposes. It will be observed that deaths registered as caused by pneumonia

may have had an origin in some constitutional condition of the system, which, if it were tabulated, might give valuable information. The table as at present constituted places deaths, which have had a similar origin, in every part of the list. I would suggest, as a necessary alteration of the law regarding registration of deaths, that the certificate which details the cause should be transmitted direct to the registrar; that it should be a confidential document, the nature of which the registrar should be prohibited from disclosing; and that it should be the property of the State alone. I make this suggestion because a large portion of the deaths which now arise are due to causes which are not, and cannot be, registered. I especially refer to those which have had a syphilitic origin, or which have been caused by continuous indulgence in intoxicating drinks. A very large portion of the diseases which affect particular organs, and in which the first starting-point is a kind of fatty degeneration of tissue, have their origin in the habitual use of intoxicating liquors. Head, heart, liver, kidney, lung, are all subject to this change, and the consequences are diffused over the whole list. The Registrar-General's returns, as at present constituted, give but little real insight into the habits of the people.

It is necessary for every family to have some knowledge of their hereditary tendencies, before they can take the best measures for the removal of such tendencies from their own persons. The prevailing diatheses and the hybrids which arise from inter-marriage must be recognized and treated accordingly, if good health is to be obtained. Treatment must not be limited to those times at which there is a local manifestation of disease. Prophylactic measures are necessary in apparent health, as well as during actual illness. It is a mistake to suppose that the date at which a given illness has apparently commenced is that at which it really began. In the case of pneumonia, for instance, it may simply announce the moment at which the mischief has reached the boiling point; it may be the evidence of an attempt on the part of nature to rebel at the treatment to which the body has been subjected, rather than to the actual commencement of ill-health. It is an effort of the system to throw off morbid matter and to commence its active removal. A dwelling-house is not a comfortable place to live in whilst repair and redecoration are being carried out. The necessity for repair and re-decoration commenced some time before the workmen were actively set to work. It is not less so with the human frame. Illnesses are the means which nature sets up to throw out morbid or used-up material. It is generally the patient's fault,

either from ignorance or wilful disobedience to law, if an organ become damaged in the operation. I wish particularly to dwell upon inherited tendencies, because it is often said that they belong to the inevitable, and families subject to them have to submit. This is not so; they can be removed. There is no reason why delicate persons should bring up delicate children, provided they are brought up in obedience to the laws of health; but, if they be coddled because they are said to be delicate, if they be removed from all those influences which make people strong and healthy, especially if they be made to take intoxicating drinks as a matter of course, they will be like a naturally hardy shrub which has been kept in a hothouse and not allowed to experience the changes from heat to cold, or to feel those winds and storms which rivet it more strongly to the soil. If afterwards it be planted in the open, it dwindles or remains a poor little shrub, liable to be acted on by blight, and is easily broken down by a moderate tempest or destroyed by a cold night. So it is with human beings if they be not in due time exposed to the changes which arise from heat and cold, to drought and moisture, to exercise and proper changes of food, and kept from stimulants. It is impossible for them to reach a healthy and vigorous manhood, or to go to the grave without the infliction of organic disease.

It is all-important for individuals to be aware of the tendencies which they may have inherited. He who has a gouty constitution or a tendency to fatty degeneration from indulging in excess of certain matters, may live quite differently from one who has a tubercular diathesis; whilst the man who is more easily affected by malarious disease should avoid conditions which scarcely affect the former at all.

The time has not yet arrived at which it will be possible to speak with much advantage in a public assembly regarding general diseases. Our work, as far as this Congress is concerned, is to deal with those causes which produce malarious or zymotic disease, and lessen the general health of the people. The incidence of the malarious class does fall more heavily upon some families than upon others; and some suffer much more fatally than others, as if they were pre-disposed to become its victims. At present, we have no certain knowledge as to the reason for this. The class itself is quite capable of prevention. The causes which lead to it are produced by circumstances which are absolutely removable, either by the State or individual action. I have been accustomed to treat

this part of my subject in the light of an algebraic equation, in which I assume that enthetic or zymotic disease is made up of members represented by $x\ y\ z$, the problem being to find the value attached to each member of the formula $x\ y\ z$. By enthetic or zymotic disease I mean any of those diseases which belong to the zymotic or infectious classes, and which are dependent for their increase upon matter which has been in contact some time or other with another and a similar case. I will explain the value which I apply to each member in the formula. x represents the human body as it should be in health. Each function or endowment of the body as performed leads to the production of some used-up material. This is represented by y; it always exists more or less in the blood, or is stored up as formed material, and cannot be used again for the same purpose. It is always in course of removal by the excretory organs of the body. It should be kept down to a normal standard, otherwise the natural balance is destroyed, and something goes wrong. z is matter from without. It is upon y that z increases and multiplies. If the quantity of y be normal, there is nothing for z to grow upon, for it will not flourish in the blood and juices of a healthy person. If, therefore, every function of the body be properly performed, if every endowment be naturally used, the introduction of z is comparatively harmless. It is only upon excreta or used-up matter, either in or out of the body, that z can grow. If y in any shape be abundant in the blood, and not removed as fast as it is formed, z increases and multiplies in that blood, and induces changes in it which may be incompatible with life. If there be little pabulum, the case is a mild one; and, if that pabulum be of very slow growth, it may be a long period before the patient can be liable to a similar attack again, and it may induce such conditions as may render a recurrence an impossibility. Two members of the formula $x\ y\ z$, cannot produce a case of disease. The whole three must be present. x and y alone cannot produce it, neither can x and z if y be kept at a natural standard; for, if z happen to be introduced into the body, there is nothing for it to grow upon, and it aborts. We cannot keep out y altogether, for it is formed in the very act of living. It is a sequence of life. If, therefore any special endowment of the body be not sufficiently exercised, or any function not properly performed, there is an alteration of the balance, and pabulum is provided, of a debased character, for morbid matter to run riot in. Thus it is that diseases of the enthetic class are epidemic at some times, and not at others, and among some people, and not among others, fatal effects more

certainly following in those whose blood or other juices contain particular forms of impurity.

Each type of disease requires a different kind of pabulum for its production, just as wheat grows better in some soils than in others, whilst there are soils in which it will not grow at all, but where water-grasses flourish. So we have scarlatina abounding among one set of people, typhoid fever among another, and dysentery among a third. There is nothing more curious or out of the way in the rise and fall of epidemics than there is in the abundance or scarcity of certain forms of vegetable life, according as the season is dry or moist, or hot or cold, and according as the material required for its nourishment is abundant or the contrary. At any rate, z is required for the production of a case. You ask as to its nature. z belongs to the vegetable kingdom; it may be very close to that part of the organic world which Dr. Allman recently described at Sheffield as the starting-point for both vegetable and animal. On the nomination of Mohl, he has styled it protoplasm. Mr. Huxley calls it "the physical basis of life." Dr. Allman says it is a liquid. I join issue with him upon this point; it is not liquid, it is not volatile, but it is particulate; and, although he calls it liquid, his own admissions imply a belief in its particulate character. Those granules to which he alluded so forcibly in his address at Sheffield are solids, however much liquid they may have attached to their constituent substances. They are totally destitute of structure, as far as our finite appliances can make out, but they are possessed of contractility, and are endowed with some vital principles quite beyond our microscopical powers to discover. It is not possible for any one to say that they are really structureless, because we cannot see their parts. They are differentiated in their functions and in their powers, and must therefore be differentiated in their matter, which could be seen if our powers were equal to their minuteness. To assume that our knowledge is final; to conclude that they must be structureless, because we cannot see their structure by our present microscopical aid, is as unsound as for anyone to declare his disbelief in the planet Neptune because he cannot see it with his naked eye. It is one of the weak parts of Dr. Allman's address in which he concludes that we have reached the limits of our powers, and that protoplasm must therefore be structureless. I consider z to be a particle of protoplasm altered in its functional power, so that it is capable of development only when it comes into contact with used-up matters which are the proper excreta of humanity; and just as the germ of the common mush-

room cannot germinate unless in contact with the excreta of some of our domestic animals, so the germs of enthetic disease fail to multiply if used-up matter in its proper form be not provided for it. $x\ y\ z =$ a case of enthetic disease; the problem is how to prevent its extension. z is thrown off in abundance from every case. It increases and multiplies out of the body as well as in it. It is an organic living particle which can flourish and propagate its kind, if pabulum be provided for it, but which cannot do so if the requisite matter be absent. The great work which the sanitarian has to perform is so to dispose of excreta that the human body shall not return within its own economy the used-up matter upon which it has fed, and which has resulted from the performance of its proper endowments, nor yet keep within reach any of the same materials by means of which z may be allowed to multiply, and at some future time be introduced into the system of another person, and so re-produce the disease. z is neither liquid nor volatile, but is a solid particle, which in some forms can be seen and weighed, and is as much a living particle as the germ upon which the dry rot in wood or potatoe-blight depends. Its position in the organic world is now definitely established to be vegetable; and, reasoning from analogy, there are some facts which are proved regarding some members of the family which it is fair to assume as applying to all. I am not going into the moot point of germ-theory as opposed to glandular theory regarding the production of disease. It may be that the truth lies between the two, and that the fatal result arises from the secretion of the vegetable germ, rather than from the speck of albuminous matter of which it consists. It may be that these growths produce a poison similar to snake-poison or woorara in its effects, and which kills by its action upon the nerve-cells of the body. It may also be that the eruption of scarlatina or measles may be caused by an acid produced by the micrococcus upon which the disease depends, allied to formic acid in its chemical characters, but which is so evanescent in its nature that the chemist cannot catch it any more than he can catch the poison which kills in a case of cholera. These are at present speculations; but they are lines upon which it is probable that future discoveries may be made.

There are four distinct and specific forms of infectious fever in which it has been proved that, coincident with the disease and accompanying it through its stages, there are forms of vegetation in the juices and tissues of the body which decidedly differ from normal states, and which are always associated with the disease in question. The pathology of these infective processes has been

thoroughly worked out by Dr. Burdon Sanderson; he has, guided by the work of eminent Continental pathologists, himself verified the facts, and they come before us with great authority. It seems to be fairly proved that small-pox, sheep-pox, splenic fever, and relapsing fever are propagated by vegetable organisms. They were made out by Dr. Keber of Dantzic in 1868; and Dr. Sanderson tells us that Professor Cohn of Breslau has also made out that the organisms which are present in vaccine lymph are also found in the lymph of variola, so entirely similar as regards form and development that it is impossible to draw any distinction between them. Professor Cohn gives a graphic description of these appearances, which is published in Mr. Simon's report to the Privy Council on Scientific Investigations for the year 1874. The same paper contains an account of the investigations of Dr. Weigert of Breslau as to the existence of micrococci in the lymphatics of the skin in persons who had died of small-pox. Dr. Sanderson says (page 32): "That organisms of a particular form existing in the lymph of small-pox, taken in connection with the occurrence of similar organisms in the channels of absorption leading from the pustules, suggest the probability of these having to do with the morbid process, but cannot be accepted as proof that they possess the property of propagating the disease. For the establishment of such proof, it would have to be shown either that, when deprived of its organisms, though otherwise unaltered, it is deprived of its activity; or that, when the organisms are introduced alone, they manifest the contagious property of the liquid or tissue from which they are derived." It has been shown that many contagious liquids lose their activity when they are deprived of their suspended particles. This has been shown over and over again in the case of vaccinia; but the *per contra* must be regarded as impossible, because the bodies themselves are so minute that there is not the slightest prospect of any one being able to separate them from the containing liquid in anything like a state of freedom.

There are methods of investigation which approach very clearly to the required conditions, and which enable us to assume with some degree of certainty that the organisms, if not themselves the cause of the disease, are always the vehicle by means of which the cause is carted about the country. We cannot investigate the pathological condition under which small-pox is produced in those stages in which it is most important to gain information, but comparative anatomy enables us to bridge over the chasm. Sheep are subject to a disease which is the exact counterpart of small-pox.

It is precisely similar in its origin, its progress, and its manifestations. Dr. B. Sanderson tells us that the virus contains organisms similar to those of small-pox and vaccine. The result of the investigations which were carried out by Dr. Klein can leave no doubt in the mind of any reasonable man as to the connection between the vegetations and the disease. He describes them as necklace-like filaments, of jointed structure; in some they are granular, which, under the highest possible microscopical powers, are seen to be highly refractive spheroids; in others, the filaments were so dense as to present the aspect of a felt-like mass, such as is seen in similar growths. He concludes that the highly refractive spheroids are the forms which are characteristic of the lymph in sheep-pox in its active condition. He was able to trace separate conidia in a state of germination, and, by their life-history, to connect them with vegetable matter.

There is another disease to which animals are subject, called splenic fever, or Milzbrand. It is sometimes called splenic apoplexy. It occurs in the horse, as well as in the ox, and was the first disease with which a specific organism in the blood was clearly associated. The peculiar staff-shaped bodies which are always contained in the liquor sanguinis in this disease were first made out in 1855. The most striking feature of the disease is its rapid progress; it runs its course in a few hours. In the horse, it is often called acute splenic tumour; it is accompanied by carbuncular infiltrations of the mucous membrane lining the alimentary canal. The carbuncles are not so often met with among cattle as they are in horses. The discovery of the rod-like bodies which always accompany the disease was made by Pollender. A year or two afterwards, Dr. Brauell confirmed Pollender's discovery (Virchow's "Archiv"); he considered them to be diagnostic of the disease. Other physiologists have corroborated these observations, and have shown that the rod-like bodies are from $\frac{1}{3500}$ to $\frac{1}{2000}$ of an inch in length, the width scarcely admitting of measurement. Although the evidence was much doubted at first, it is now agreed by all physiologists who have inquired into it that the rods are living organic bodies, and can communicate the disease to apparently healthy animals. The activity of the rods is dependent upon their vital functions; and, whether the rod is the absolute cause of the disease or not, it is always present, and the disease cannot be propagated without it. A curious fact has been established regarding it. The rods do not pass through the membrane which separates the mother from her offspring; and, when pregnant animals are affected by splenic fever, the blood of the embryo is not contagious, and does not contain the staff-shaped bodies.

There are two other points which have been also proved regarding splenic fever. The contagious property as it exists in the circulation is only temporary. Dr. Brauell tells us, through Dr. Sanderson, that the moment the blood shows signs of putrefaction, it loses its infective power. The motionless rods give place to actively moving bacteria, which are not capable of spreading the disease. This point is an important one with regard to the incidence of other and similar diseases. It has been shown, also, that the actively-moving bacteria are not the progeny of the splenic rods, but appear rather to have eaten them up, and to have acted upon the dangerous organisms much as the infusorian animalcules and entomostracan crustaceans do in impure water, viz., remove the *materies morbi* from the liquid, and are friends and not enemies. But the contagium has also a stage of existence in which it is highly resistant. Bollinger tells us of ten cases which occurred in one stable near Zürich, between August 1868 and February 1872; there were no other cases in the neighbourhood; other horses and cattle surrounded the stable. The contagious agent must have been latent in that stable during the period in question. Each case appeared to arise independently of the preceding one, and indicated a form of contagion quite different from the staff-shaped bodies which disappear so soon from an acute case of the disease.

Some of you may ask the question as to what splenic fever in the horse has to do with the prevention of disease among human beings. I say much, because these same rod-shaped bodies have been discovered in the blood of human beings who have died of fever. There is a disease not unfrequent upon the Continent, which is termed by Buhl of Munich "mycosis intestinalis;" intense infiltrations occur in the mucous membrane with extravasations of blood. It was known in some of the cases that there had been communication with animals similarly affected. The tissues of the infiltrated parts were infested with the staff-shaped rods. These discoveries give us a clue to the causes of those infiltrations which arise in the course of other fevers. The rods are not there, but there are myriads of microzymes which have superseded some forms of life which corresponded with the rods. They may also explain to us the causes of those congestions which frequently arise in the ordinary fevers of this country, and which are followed by hemorrhages, abscesses, and enlargement of glands. The congestions may be caused by a mycosis, which is a colony of vegetable

organisms, but they become changed in their character before it is possible for them to be examined by the microscopist. "It may be that the presence of these bodies is as much a part of the process as the emigration of the colourless corpuscles from the blood-vessels is a part of ordinary suppuration."

The fourth form of disease which has been clearly associated with living organisms is relapsing fever. It was first proved in Berlin by Dr. Obermeier, who unfortunately died of cholera whilst making his investigation, and probably lost his life by his devotion to science. The presence of the organisms in the blood, and their association with the fever, were clearly made out. They disappeared as the fever subsided, reappearing when a relapse took place. The morphological and botanical characters of the organisms were subsequently determined by Professor Cohn, and a place found for them in the vegetable kingdom. They are proved to be spirilla, belonging to the group spiro-bacteria of the natural order *Schizosporeæ*. This genus he has placed in the family of Oscillatoriaceæ, of the class *Algæ*, or seaweed. By means of this classification, we are able to see daylight, as regards these forms of disease. Another eminent botanist, Dr. von Naegeli, has classified micrococci under the name of *schizomycetes*, and connected them with the great family of fungi. There is much to favour this notion; but the aerial nature of the fructification of fungi, as opposed to the aqueous forms under which the algæ flourish, leads me to conclude that the micrococci are algæ rather than fungi, especially in those forms of disease which are propagated by the agency of water.

The spirillæ of relapsing fever are always present during the hot stage. They cease to be visible after the temperature has fallen. They can be kept alive for a short time out of the body, and there is evidence enough to show that they can propagate the disease. The contagiousness of the fever, the tendency to recur which its name indicates, and the coincidence of living organisms pathognomonic of the disease, are clearly established. The number of the organisms increases with the increase of temperature, and seems to point out that the rise has something to do with the vegetable growth, somewhat after the course which follows during the germination of ordinary seeds. The rapidity with which the multiplication goes on in a congenial soil; the fight which takes place between the natural order of things and the unnatural; the effort to throw out the foreign material, all have their significance and find their analogy in all the class of enthetic diseases, from plague and cholera at one end of the list, to a simple ague fit at the other.

Besides the four diseases I have mentioned, some observations have been made regarding the communicability of diphtheria. Cryptococci, or cacozymes, as I prefer to call them (to distinguish them from the microzymes which are derived from healthy protoplasm), are found in the diseased tissue, and are said to spread the complaint. Diphtheria has been propagated by taking diphtheritic exudation from a case, and inoculating animals with it; a similar disease has then been set up. Similar processes could not be induced in the family organism simply by putrescent or decomposing material. Dr. Sanderson does not consider that this has been satisfactorily proved, but others have thought the evidence fairly sufficient. It would be inexpedient, even if it were possible, to prove it conclusively. To inoculate a human being with matter from a diseased animal is an experiment which is not likely to be made, but the facts deposed to by Dr. Oertel of Munich have their significance.

The certainty with which glanders can be propagated from animals to human beings is well known, as also in the case of malignant pustule or "charbon." The alliance of the latter disease with carbuncle, and the connection which may be traced between it and diffuse cellular inflammation, erysipelas, and hospital gangrene, are also well known facts. Thus we have connecting links with numerous diseases which are infectious, and which are propagated by morbid matter from man to animal and from animal to man. But the operation is not limited to its effects upon animal life. Rust, smut, and their allies among fungi, bring occasional ruin upon agriculture. The *Peronospora infestans* is likely to remove the potato from our list of common foods. Another form of the same family, the *Botrytis bassiana*, is the terror of the silkworm grower. The salmon fisheries have been seriously damaged by the ravages of living vegetable organisms; whilst, at this present time, the vine grower is in intense alarm on account of the ravages of *Phylloxera vastatrix*. The aspect of the vegetable kingdom is sometimes changed by parasites. The potato blight has an ordinary fructification, which is aerial, and can only be produced under special circumstances. There must be an excess of carbonic acid in the atmosphere, something not very considerably above the four hundred parts in a million which naturally belong to it. There must also be an excess of moisture and an absence of sunlight. These adjuncts are required for the rapid production of the ordinary fructification of the peronospora. If a bright sun and a drying wind arise at the proper time, the loss of a particular crop may be

averted. The ordinary fructification, and even the mycelium or root-matter, are evanescent; but it is not so with another form of fruit, which is found among the *débris* of the damaged crop, and sometimes in the rotting tuber. The resting spore continues to live; it is enclosed in a material capable of resisting the action of heat and cold, of sunshine and of rain, and has even germinated after being in boiling water for a short time. These spores probably exist in the soil, ready to spring up into activity whenever the necessary meteorological conditions arise, and continue long enough to allow of their germination. The genus Peronospora has a wide distribution, and it affects a large portion of the vegetable kingdom. How far it is possible from the protoplasm from which it springs, to change its character—say, from bassiana to infestans, according as it attaches itself to the caterpillar or the potato-haulm—is one of those problems which some physiologists say to be contrary to nature, but which I consider to be within the range of probability. One thing is certain, that the same parasite can equally affect both classes of organic nature. It is thought by some that fungi only attach themselves to, and can only subsist upon, those plants which are only weakened by some causes. This would only be following the rule which I believe to apply to human beings; but then the parasites themselves, by their irritating secretions, are able to induce a condition which allows them more play, and by producing debility enables them to take possession of their victim with greater rapidity. There is a second problem which requires solving; it is of great importance, viz., how far vegetable tissues which are diseased by fungous growth are capable of affecting the animals which feed upon them; and again, how far animals which have become affected with disease are able to spread that or some other form of disease, not only among their own species, but to other animals and to man himself, if he feed upon their diseased flesh.

I have mentioned the experiments which indicate the possibility of diphtheria being propagated from man to animals. Glanders can arise in both classes. Vaccinia is a disease common to both. There seems to be no difference between small-pox and sheep-pox. The transmission of trichina from animal to man is undoubted, and the communication of tapeworm is not uncommon. Cases of malignant pustule are obtained by infection from animal to man. There are several other diseases which arise either from contact, or as a sequence to the consumption of diseased meat or bread; and gangrene is not an uncommon result of the consumption of spurred

rye in those districts upon the Continent in which rye-bread is used. The secale or spur of ergot is a mass of fungous growth belonging to the class *Clavicepe*, a genus of ascomycetous fungi. Its consumption is followed by a condition of the tissues which produces gangrene. There are some curious facts connected with the fructification of this plant; there is the production of a multitude of spermatia and so-called stylospores, which have active movement in air; they are motionless in water, but they soon germinate and emit filaments, and are ready for action in congenial soil.

We cannot look upon the diseases of organic nature with perfect complacency; we must not consider that they only affect our pockets, and not our health. Before English people can have that perfect health which is the birthright of every child born into the world, it will be necessary to alter our plans regarding the breeding of cattle, and the methods of housing and feeding them. Our domestic animals fall an easy prey to every kind of epidemic. For all Sanitary law is, as a rule, ignored by the farmer. Knowing something of the customs of the country, I was not surprised when I heard an inspector from the Metropolitan Meat Market declare upon oath, in Croydon Police Court, that 80 per cent. of the meat which was sent to the London market was the subject of tubercular disease, and that, to exclude it from the market, would leave London without a meat supply. The foul air in which animals are often kept, the foul water with which they are supplied, and the musty food which is given to them to eat, easily accounts for the readiness with which they fall victims to every kind of malady. The deaths among cows during the calving process is very great, and is one of the reasons why meat continues dear. Such deaths ought not to occur at all. We cannot remove disease from our midst, or reduce our death-rate much below 17 in the 1000, until we can ensure a more healthy progeny among our domestic animals. To do this, something more is necessary than to insist upon measures for the prevention of disease among men.

I have mentioned the position that organisms producing relapsing fever occupy in the vegetable kingdom. The spirilla belongs to the class *Algæ*. Professor Cohn has placed in the same class all the germs which give rise to epidemic diseases among men. It has been proved that bacteria are not the actual producers of these diseases; Cohn places them, however, in the same list, under the name of *microbacteria*, in a class by themselves. The micrococcus is grouped under the name of *sphærobacteria*, and divided into three

classes, viz.: 1. Those which give rise to colour like to that which causes "red snow;" 2. Those which cause a certain class of ferments; and 3. Those which produce pathological changes in the blood. I should alter this classification into micrococci and cacozymes —the harmless and the hurtful forms. I must, however, refer you to the list for the complete classification.

The peculiarities of fructification which belong to the Oscillatoriaceæ in which we have an evanescent and also a persistent form of germ, and with the evanescent an extraordinary power of motion, by means of which they are enabled to insinuate themselves deeply into living tissues (especially if those tissues are not normally healthy), is one of the wonders of their mission. Having found entrance within the portals of a living thing, they assert their individuality, and soon produce a new crop of similar material, provided there is pabulum suited to their requirements. This pabulum appears to be used-up matter of different kinds. It may be that different forms of disease are produced from similar germs, according to the position the germ attains to, or the food it has to assimilate; just as the head of the tænia becomes by transposition a hydatid cyst in the human liver, or gives rise to the staggers when it affects the brain of the sheep. It may be also that there are forms of vegetation induced by transplantation which can only be produced in that way; just as the common mushroom spore cannot germinate unless it has come into contact with the excreta of some domestic animals, so it may be possible that some of our diseases can only arise by the introduction of a proper germ at a time when it can come into contact with some other agent which is as yet unsuspected of having anything to do with the process. The large class of gregarina which exist as parasites within the bodies of animals from the highest to the lowest forms, having vibratile cilliæ and capable of much active movement, multiplying with extreme rapidity, have functions which are not yet determined. It may be that these parasites are powers in the equation $x\ y\ z$=enthetic disease; some of them or their allies may be necessary to enable the particle z to increase and multiply, and may account for their fertility in one person who has been infected, whilst another escapes.

This is not a far-fetched and chimerical idea, for Professor Dodel Port of Zürich points out that the fructification of the *polysiphonia subulata* (one of the red sea-weeds of our coasts) is completed through the agency of the beautiful little vorticella. A ciliated infusorium occupies the same position in the process that the bee occupies in the fructification of the willow catkin. But these are

points which botany has not yet determined, and I must leave a very enticing subject for more important and more practical work.

I will now go on to what I call the canons of Sanitary work. The basis upon which preventive medicine stands as a science is that of the *particulate nature of contagia*. It is the first canon law. We know that zymotic disease will not arise if the particle z is kept out of the process. Again, z cannot increase and multiply unless the material which has been used up in supporting the functions of the higher forms of life be also present. There are, therefore, two manifest duties for the Sanitary authority to perform: First, to remove the pabulum y, upon which z is able to increase and multiply, from its neighbourhood to man; and also, so to alter its character that it is no longer able to nourish z if the particle should be imported; second, to prevent the importation of z, or if it be in our midst, so to alter its nature that it cannot fructify. These duties can be performed if the laws which regulate the introduction and the growth of z are well understood and counteracting agents regularly employed. There are two forms of germ, the evanescent and the persistent. Measures which may be successful against the former and may limit the spread of a present epidemic, will not necessarily prevent its recurrence in the future at the same place unless both kinds of germ are considered.

There are several ways by means of which the natural order *schizosporeæ* may make itself felt, viz., by the air, the water, the earth, or the food. The contamination of the air in the neighbourhood of our dwelling-houses both above and below the level of the ground must be counteracted. This contamination is effected in two ways: 1. By the ordinary processes of decay which are always going on in organic nature; and 2, By the aggregation of living creatures. Both give rise to excess of carbonic dioxide; without the latter, it is probable that fungi could not flourish, but it is animated nature which introduces myriads of the germs of debased protoplasm which is food for z to flourish in.

The higher the animal life is in the scale of creation, the more injurious is the excreta of such animals, and that of man most of all.

The remedy for these evils is *ventilation;* anything which impedes it is contrary to Sanitary law. *Motion* is the second most important fact, and is the *second law* of Sanitary work. Currents of air must be established to lessen the quantity of carbonic dioxide to something less than four hundred and fifty parts in a million; and by introducing a fresh supply of oxygen, the albuminoid matters which

living creatures give out may be altered in their chemical characters, and by that means they will no longer give renewed life to *z*. Motion of both air and water is a principal law of Sanitary work. Air in motion is soon deprived of those organic matters which allow the growth of *z*, and the latter, as well as the food upon which it feeds, being very evanescent in its character, are soon changed into innocuous and even into useful matter. This was very forcibly impressed upon my notice in the year 1854, when I ventilated the soil-pipe of my own house by extending it upwards between the sewer and the trap; my successor in that house took away the soil-pipe, and in a few weeks a death from typhoid fever occurred in that house. Stagnant-air in the house-drains of this town produced more or less evil in almost every house in the place, until our local senators were convinced of the evil. It was in Croydon that the law for ventilating sewers was first put into operation by a local authority. But the local authority were then in advance of the intelligence of the people; and, although the command was issued, the work was not generally done until much more proof of its necessity was afforded. Now, the ventilation of the sewer and of the house-drain is required by the law of the land, but it is not nearly so general as it should be. Those openings into sewers were at first called stink-pipes, and were sometimes taken away because they gave evidence that the law of motion was not complied with. The foul smell which came out, showed that the sewer was a sewer of deposit, that it contained stagnant sewage; and the neighbour, like the ostrich of the desert, who when danger threatens hides its head, takes away the safety-valve and tries to smother up the evidence which the stink-pipe gives out, and sends it into somebody's house, instead of insisting upon the removal of the foul sewage from the sewer. No smell will ever arise from a properly constructed sewer; and if there be such a smell, it is conclusive proof that there is a deposit either in that sewer or in some other in close communication with it, or in the soil around it. No stagnation, either of air or of sewage, should be possible in any sewer.

Assuming that sewers are necessities in a thickly-peopled neighbourhood, they must not be allowed to ventilate into houses; and now a *third law* comes into operation, viz., that it shall not be possible for air to pass directly from a sewer into any house until it has been diluted by pure air and has had time to have its albuminoid matters oxidized. *There must not be any communication directly between the sewer and the interior* of the house.

There is no occasion for any departure from this law, and it should never be allowed in practice.

There is another danger which arises from sewers if they are not constructed of impervious materials; brick sewers are open to great objection when they pass through pervious soil in close proximity to houses. Unless they are very freely and efficiently ventilated, they contaminate the air of the subsoil of a town until it becomes a perfect hotbed of mischief. This is a frequent cause for the continuance of enthetic disease in districts in which the water-line rises and falls at distinct intervals. The way in which gases travel long distances underground is sometimes shown by the distance which coal-gas travels when a fracture has taken place in a gas main. Sewer-gases, which only form in badly constructed sewers, are just as penetrating. The products of decomposition find their way through the bricks into the soil, and then into the foundations of the houses. There are some houses in this town which are built over sewers, and which must sooner or later be dangerous to the occupants. The builders of such houses ought to be compelled to notify the fact to every incoming tenant. Ventilation should be provided in every case in which a trap has been fixed, otherwise stagnation must arise. This is another fundamental law.

The next *law is that sewage must be utilized.* It must be conveyed as soon as it is formed away from the neighbourhood of human beings. *z* is found to flourish most luxuriantly in sewage which is about to undergo putrefaction, but in which putrefaction is not actually established.

The safety, as far as it is safe, of the old-fashioned cesspool out of doors arises from the fact that putrefaction is rapidly set up, and with it all danger from the multiplication of *z* is removed. This is also seen in the dissecting-room, or at *post mortem* examinations. There is much danger from dissection-wounds for a few days after a death; but if a student cuts his finger whilst dissecting a body in which putrefaction is advancing there may be an ugly sore, but there will not be a poisoned wound. In the cesspool, *z* may be indefinitely multiplied before putrefaction is established, and germs of mischief may find their way out of cesspools into wells and water-courses, and may do much mischief. No Sanitary authority ought on any pretence to allow a cesspool to exist within its jurisdiction.

If there be no sewers, and I contend that they are not necessaries in a thinly-peopled district, excreta should be reserved in some

utensil in contact with earth or some other deodorizer able to arrest the changes which otherwise must take place, and before the power of change can re-assert itself the material should be taken away and utilized in the ground. The pail system is far safer and far more economical for a village population than a system of sewers, and it is a serious blunder to introduce into small places the works which thickly-peopled cities require; but then the work of collection must be controlled by an efficient local authority. Sewage which has been removed from the town by water-carriage must be applied at once to the land by means of surface-irrigation. This subject has been repeatedly mooted at Congresses, and by inquiries made by Royal Commissioners and Committees of both Houses of Parliament, and the general conclusion which has always been arrived at by unbiassed witnesses has been similar to that which was agreed to at the first Sanitary Congress ever held in this kingdom. In October 1866, the Leamington Sewage Congress, after a long discussion in a large assembly of scientific and practical men, agreed to the following resolution: "That the system of irrigation, when carried out in a scientific manner, removes the difficulty which now arises from the present noxious plan of polluting the rivers of England." A rider was added, which caused it to be unanimously accepted, viz.: "But that there are circumstances in which other systems may be applicable." Thirteen years have passed away since that time, and I am still more convinced than ever of the truth of the following conclusions:

1. Sewers are necessities for crowded populations.

2. Having sewers, they are silent highways along which human excreta may be safely and efficiently removed by water-carriage.

3. Sewer-gases and smells from decomposing sewage are not necessities of the system.

4. If sewage be judiciously applied to land, the spread of enthetic disease by its means becomes an impossibility.

5. After a proper application by surface-irrigation, the effluent water may be safely discharged into the nearest water-course.

6. The application of sewage to land must be conducted on scientific principles; otherwise failure, first financially, and then by producing nuisance, will arise.

7. A local board is the worst possible body to have the management of a sewage-farm. The management requires an intimate acquaintance with several sciences, with agriculture, with sale and barter, and an immediate personal command of capital: without these powers it cannot become a financial success. The manager

of a sewage-farm must be an autocrat and not be liable to those attacks which are certain to be the lot of active members in a popularly elected local board. The Croydon Local Board, with the best intentions, will have to reap the harvest which is sure to follow from the farm having too many masters; and the ratepayers of the parish who did not know when they were well off, and who are primarily responsible, will have to pay the ultimate cost.

The eighth conclusion at which I have arrived, is that a local authority, in providing for the utilization of sewage by irrigation, must be prepared to pay the difference in value between the price of the land and its ordinary agricultural worth. One penny in the pound on each rate, or at the most threepence for the year, ought to be amply sufficient for this purpose, as well as for the payment of interest on money sunk in unexhausted improvements. The Beddington farm, which has now been in operation more or less for twenty years, costs more than this; but if the farm had to be formed now, the experience which has been gained (if it were available, and if members of a local board could condescend to think that anybody else knew what was wanted better than themselves), would enable the board to carry out the work at a much less cost. I say if that experience were available; but, unfortunately, local self-government tends to scatter experience to the winds. Those works, upon which considerable sums of money have been sunk in as yet unexhausted improvements, are not followed up, because present managers do not know anything about them.

The ninth conclusion to which I have come is, that although sewage should be conveyed to the soil as rapidly as possible, *rainfall* should go to *river*. It is a wrong thing to conduct rainfall into sewers, as by this means a sewage-farm is swamped with unnecessary water. Not that storm-water from the streets of London should be sent into the Thames, or the washings of thickly-peopled cities at once into the water-way, but ordinary surface-water should be strictly excluded, and when possible, the rain-water from house roofs should go to the water-courses. This is a good reason for excluding sewers from thinly-peopled districts; ordinary sewers will only drain the subsoil, empty the water-courses, and dry up the smaller sources of our rivers, and produce as much evil in the subsoil as cesspools now do. They are serious blunders too—often perpetrated for the personal benefit of private individuals.

The sixth great law of Sanitary work is for sewer and water services to be decidedly separated, so that no interchange of either liquid or gases should be possible. It was shown not long since,

that just where a water-pipe passed over a sewer, there the pipe was defective, and as a consequence a serious epidemic arose. Sewage soon decomposes iron; and if water-pipes be allowed to lie in sewers, and to occupy portions of cesspits on the roadside, or to be in communication at those points at which water is delivered into a house and slops and sewage removed, there can be no real safety for the people. I am sometimes astounded when I hear men who put themselves forward as Sanitary authorities utterly ignore this fundamental law.

The seventh law is that the *individual house* is the unity of Sanitary work, that it is in each house, and it is with each individual that the first action must be taken to diminish the power of *z* to grow and produce its kind, whilst should *z* be introduced, it is the *individual case* which is the unit of repression. But all these canon laws have their foundation upon the particulate nature of contagia, and it is by bearing this one fact in mind that Sanitary work can produce sufficient fruit to be successful.

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On Certain Points with reference to Drinking-Water.

MUCH controversy has taken place with reference to the subject of drinking-water, and indeed we may say that no part of the wide field of Hygiene has formed more frequently the battle-ground of the partizans of different theories. Many things have contributed to this: a too great tendency to generalization from insufficient data; a too great dependence upon the dogmatic opinions from time to time enunciated;—a tendency to misrepresent the views of opponents, &c. All those things retard true progress and are apt to bring hygiene more or less into discredit. Thus it is asserted by some who are opposed to the so-called "water theory" of disease, that its supporters insist that this is the only means of propagation. I need hardly point out that this is erroneous, for I am not aware that this has ever been insisted upon by any one whose opinion has carried any weight with it. Another accusation is this: that, by demanding the presence of a germ or *materies morbi* in water, as a *sine quâ non* for the production of a specific disorder, the science of hygiene is actually retarded and attention drawn away from the necessity of having pure water at all times. Here again is, I think, a mis-statement of the case, for no one has advocated the use of impure water (if we except the address of the late Sir William Ferguson, which was an instance of an eminent man stepping out of his way to treat a subject which he had not sufficiently considered). But, on the other hand, we have been obliged to admit that in some, perhaps indeed many, instances, water undoubtedly impure has been consumed for a length of time, without positive disease being directly traceable to it. Still that is no reason why impure water should be used, and none are likely to recommend it. For we are all ready to admit, to some extent at least, two points, viz.—1. An impure water is probably more likely to form a favourable nidus for disease-poison, whatever that may be, than a pure one; and 2. It is, at least, not unlikely that the prolonged use of an impure water renders an individual more open to attacks of disease, should he be exposed to them. But there is also another side to the question: there exist cases, where the evidence seems fairly convincing, that disease has been propagated by means of water which our present means of examination fail to detect the impurity of. But in this there is nothing contradictory, for assuming for a moment the verisimilitude of the germ theory, we recognize the extraordinary minuteness of some of the bacteroid points, which tax the powers of our best microscopes to recognize them. Should these organisms be propagated by means of conidia, how much more minute must they be! And if, as has been suggested by Mr. Sorby, we have already reached the greatest power of penetration by means of lenses, it is quite conceivable that we may never see a germ, even supposing it positively exists. It will also be evident that, if microscopic investigation fail to reveal its existence, still less can we hope much from chemistry in this direction.

It must not, however, be understood from these remarks that I look upon either chemical or microscopical research in this direction as valueless; on the contrary, I think they are of very considerable value, but the value has, in my opinion, been both overrated and underrated. Thus, it has been overrated when chemists have proposed to lay down certain hard-and-fast lines as to the quantity of constituents to be considered as admissible; whilst it has been underrated by those who, disgusted and discouraged by an overweening dogmatism, have given up chemistry and the microscope in despair. What, then, is the position that the examination of water occupies at the present time? First, with reference to the chemical question. The most important is undoubtedly the quantity and nature of the organic matter, and any condition of the water that may influence its changes or action. Various plans for its estimation have been adopted, but I purpose to direct attention only to the so-called albuminoid ammonia method, and to the use of the permanganate of potassium. Those two are the easiest of application on the whole, and if intelligently applied they give information of some value. The former plan has been extensively used in this country, the latter being more commonly employed abroad. Following the limits laid down by Professor Wanklyn, it has been customary to adopt 0.08 of a part per million as the limit of albuminoid ammonia in a first-class drinking water, any waters going beyond 0.10 being considered as dirty waters. Indeed, Mr. Wanklyn goes so far as to look suspiciously upon a water with more than

0.05, if there is a notable amount of free or saline ammonia. In a good many instances this rule has been applied with some rigour, and water has been condemned unhesitatingly when judged by it. But it is obvious that this method tells us little or nothing of the *nature* of the organic matter, and, chiefly, whether it be vegetable or animal. When the albuminoid ammonia is well marked and we have at the same time a good deal of free ammonia, the conclusion usually drawn is that the contamination is animal; on the other hand, in the absence of the free ammonia, it is assumed to be vegetable; and the question is still further modified by the presence or absence of chlorine. But, supposing we do assume that the organic matter is vegetable, is this sufficient? By no means; in some cases vegetable matter has been shown to be at least *probably* hurtful, in the way of inducing diarrhœa, &c.; but in others a considerable quantity may exist without any harm resulting. This is especially the case with *peat-waters*, which contain a large amount of albuminoid ammonia, and would be condemned by some chemists on that account, If we did so, however, we should have to condemn a large part of the water-supply in Ireland, and, in my opinion, very unreasonably. For instance, a number of samples from that country have come from time to time into my hands, with reference to the water supply for the troops; but where I was satisfied that the organic matter was of peaty origin, I have not condemned the water, even although the albuminoid ammonia was large. Thus: a sample from the water-works supply at Waterford yielded no free ammonia, but 0.28 of albuminoid: samples of the Vartry supply from Dublin Barracks yielded 0.132 and 0.156 of albuminoid without any free ammonia. I am afraid some chemists would have condemned those samples, but feeling satisfied that it was vegetable matter, I did not feel myself justified in doing more than pointing out that the filtration at the Company's works was imperfect, as indicated by the somewhat numerous organisms shown by the microscope. Again, with reference to the permanganate test; this we generally use at Netley with sulphuric acid and heat, reckoning the results as so much oxygen required for the destruction of the organic oxidizable matter, taking care to separate this from the nitrous acid. As a limit, 1.0 milligramme per litre may be laid down as a general guide, but much latitude must be allowed: thus the peat-waters above alluded to yielded from 1.14 in the Vartry to 3.0 in the Waterford supply. Such a quantity would be very objectionable with animal impurity, but is probably innocuous with vegetable.

It may therefore be stated as a general principle, roughly applicable, that, if we can be fairly assured that the impurity in a sample of drinking-water is vegetable, the limits usually laid down may be considerably exceeded without it being incumbent on us to condemn the water. But now comes a second question. Is this true of all vegetable matter? We may take it as generally true of peat or moorland waters, but under some circumstances it may not be true. It would, for instance, not be true in the case of contaminations from marshes of a malarious character, where I should

be inclined to make the limitation decidedly narrow; or in contamination with vegetable matter from malarious districts, such as is reported by Dr. Smart in the Rocky Mountains country, or where poisonous plants abound, &c. In the case of the Leek workhouse, Professor Wanklyn believed diarrhœa to have been caused by vegetable contamination; this may have been the case, but the evidence seems inconclusive.

The next point of importance is the significance of free ammonia, or saline ammonia, as it is sometimes called. Here the limit has been put very low, only 0·02 parts per million. When present along with albuminoid ammonia, but without much chlorine, it is taken to show contamination with sewer-gas as probable; with a marked amount of chlorine and albuminoid ammonia, contamination with sewage; with little or no albuminoid ammonia, but with a good deal of chlorine, contamination with urine; with neither albuminoid ammonia nor chlorine, vegetable, perhaps marsh, contamination. Even assuming that those inferences are correct, it is obvious that two or more of the conditions might co-exist and so interfere with the diagnosis. But is it certain that they are correct? Not in all, I think, particularly where urinous contamination is asserted of waters containing much free ammonia and chlorides, but without albuminoid ammonia. These characters are met with not unfrequently in deep well-waters—Artesian wells, in fact, where recent contamination cannot be urged. Thus the well in Trafalgar Square yields (per million) about 0·85 of free ammonia and 165·5 of chlorine (= 11·515 grains per gallon); and its analysis, I believe, at first caused Professor Frankland to have suspicions of sewage contamination. But other wells are found to yield similar results. Thus: two samples from deep wells (about 240 ft.) at Parkhurst yielded, respectively, 0·924 and 0·936 parts per million of free ammonia—no albuminoid ammonia in one case, and only a trace in the other, and from four to five grains of chlorine per gallon. Contamination is hardly to be thought of. But perhaps one of the most curious is the instance of the Spithead Forts. From a well sunk in the outermost one, at a distance of at least two miles from land, a sample was sent to me: it contained 0·5428 per million of free ammonia, no albuminoid, and about 3·9 (grains per gallon) of chlorine. Contamination here is out of the question. But where does this free ammonia come from? It is not possible to say positively, but in all likelihood from some organic matter which has undergone conversion into ammonia, but has not passed into the farther stage of nitric acid. The experiments of Schliessing and Munz, and of Warington, have confirmed the suggestion of Pasteur, that nitrification is a fermentative process, requiring a peculiar organized ferment for its operation,—the addition of substances known to be fatal, or at least obstructive, to low forms of life being efficacious in arresting the process. In the samples in question, especially in that from Spithead, there was no sign of animal or vegetable life on microscopic examination, and we may therefore conclude that the persistence of the nitrogen in the form of ammonia was due to the absence of the ferment necessary to

complete the process of nitrification. This seems to me the most probable explanation of the apparent contamination of deep-well waters, which has been a source of puzzle to a good many people.

The above remarks tend to show that, in addition to the mere chemical knowledge of the constituents, information as to the source, its nature and surroundings, and in fact as much as we can possibly get about the water, are necessary to form a correct judgment. At the same time, the laying down of certain limitations as to quantities is useful as a foundation to work upon, and this may be seen by a reference to the table, which shows the mean of 223 samples analyzed and reported upon at Netley. Of those fifty-four were pronounced to be "fit for use," that is, no excessive impurity could be detected chemically; 103 were pronounced "usable," or "required filtration;" and sixty-six were positively condemned. It will be seen that the class of "fit" lies well within the limits laid down with reference to organic constituents, and that there is a progressive increase in the two other classes. Even in the chlorine this is also observable.

Table of the Average Amounts of Constituents in Drinking-Water according to Class. Mean of 223 samples.

Class.	Chlorine in grains per gallon.	Ammonia in milligrammes per litre.		Oxygen required for oxidizable organic matter in milligrammes per litre.	Nitrous acid (Noe) in milligrammes per litre.	Hardness, Clark's Scale.	
		Free.	Albuminiod.			Fixed.	Total.
"Fit for use," or free from marked organic impurity. (54 samples.)	2·2045	0·0050	0·0258	0·3611	0·2097	5.06	12·25
"Usable," or requiring filtration before use. (103 samples.)	2·3367	0·0843	0·2062	0·8200	0·3430	5·94	11·55
"Unfit for use," on account of organic impurity. (66 samples.)	4·2612	0·4783	0·4337	0·7977	0·5927	7·71	14·68

Let us now say a word with reference to the mineral constituents. Here we find grounds for difference of opinion also, and it is much to be desired that some uniformity should be arrived at. At present we have the unedifying spectacle of one analyst declaring a water

fit for drinking, and another condemning it. A controversy of this kind is going on at this moment between two eminent chemists in London. It may be difficult to lay down any fixed rule, but something might, I think, be arrived at that would remove this discrepancy. Within some limits a difference of opinion is likely to exist, but surely a *vid media* could be found here more easily than in the case of organic impurity. Some think a water of a certain hardness necessary, and condemn too soft water; others hold a directly opposite opinion. Some even recommend the addition of salt to water; others are inclined to condemn water with even a moderate quantity of salt. In one case the sample is condemned by one chemist as unfit for washing, but allowed to be fit for drinking; whilst another condemns it for both purposes. I have myself a small experience in this direction. A series of samples lately submitted to me I felt obliged to condemn as an ordinary water-supply, on account of the large amount of mineral constituents, such as more than 140 grains per gallon of solids, of which at least 85 were chlorides and 10 were magnesia: fixed hardness 49 degrees of Clark's scale. Of this water I said that it might be used in case of great emergency, but that as an ordinary water-supply it was very unadvisable, especially in the case of children or the sick, in whom it would be apt to produce diarrhœa and perhaps aggravate other diseases. It was also, I reported, unfit for washing purposes on account of its hardness. I may mention that the source of the water was near the sea and that it was free from organic impurity. A sample was sent to an eminent analyst in London, whose analysis agreed in the main with my own; but the conclusion he drew was that it was a good water fit for all domestic purposes. Now, what is the public to think of those discrepancies? Is it likely that confidence will be placed in analysis, or is it a wonder that people should declare that chemists— water-analysts especially—and their work require rehabilitation?

On the other hand, difficulties arise, which analysts have to contend with, in ways that are but little appreciated by the public. For instance, I have had samples of rain-water sent to me, which proved full of various kinds of impurity; but I have had some difficulty in getting it admitted that such a thing was possible. "But it's rain-water!" people say: very true, but still it is impure. We might further answer, that for the matter of that, all water is rain-water, but the preservation of its purity is a question of collection and storage, whether these be done by nature or by man. Of the cases of contamination that have come within my observation the following are a few: by spray from the sea, by soaking from salt marshes into the collecting tanks, by smoke products and house refuse, by taking up caustic lime from the cement of tanks, by pigeon-droppings from house roofs, &c. These are only some, and not the most dangerous, sources of impurity. Another source of difficulty is carelessness in collection of the samples. A case illustrating this recently occurred to me. Samples from the top and from the bottom of a well were sent for examination, two bottles of each. The bottom sample and *one* of the bottles of

the top sample were fairly good, but the second bottle of the top sample was dirty and offensive, the sediment apparently consisting entirely of fatty matter. I reported that the two samples seemed from the same source by the mineral analysis, but that probably something had got into the one in question at the time of collection, assuming the bottle to have been clean. On inquiry it turned out that to obtain the sample a man had to be sent down the well with a candle, the tallow of which had quietly dropped into the well and been carefully bottled off with the sample! Still another difficulty arises from want of care as regards cleanliness of the vessels in which the samples are sent. I have had some sent in old pickle-jars, castor-oil bottles, turpentine bottles, physic bottles of all sorts, with corks of a very ancient and fish-like smell. To analyze such samples is simply a waste of time.

The best of all examinations is that which is made by the analyst on the spot itself, at the very source of supply. If that be impossible, then the most scrupulous care should be taken about the collecting of the sample and its transmission in clean glass-stoppered bottles, with every detail of information that can possibly be furnished.

I should have wished to say a few words about the microscopic examination of water, but my paper has reached the prescribed limits, and I will therefore merely urge the importance of not neglecting this branch of the inquiry. It may be said that it has not as yet done much for us—still it does furnish us with some information; and if we desire more, it is only by persistent observation and carefully noting what we see and the circumstances under which the objects are seen, that we are likely to extend our knowledge in this direction.

FRANCIS S. B. FRANÇOIS DE CHAUMONT, M.D., F.R.S.

Interpretation of Water Analysis for Drinking Purposes.

DR. SWETE to some extent travelled over the same ground as Professor F. de Chaumont. The earlier portion of his paper was occupied with an account of the different processes employed for the determination of organic matter in water, and a discussion as to the value or advisability of each in a Sanitary point of view. He then proceeds as follows:—

"Now having gained these chemical data, will they be sufficient without further observation or knowledge of the source of supply to enable us to give a reliable report? I may answer, Yes, in bad waters, for there the data will be in excess, and there can be no reasonable doubt in our minds; but without more general information many polluted waters may be passed over, and apparently bad waters

condemned without sufficient reason. The following extracts from notes of water anlyses in different localities will illustrate my statement:—

WATERS IN POROUS STRATA.

	Solids.	Chlorine.	Free NH_3.	ALBNH_3.
Leamington. 100 wells; 30 good.				
Lowest	22	1·5	·00	.07
Highest	216·8	19·	1·76	·48
Average	101·7	7·4	1·50	·18
Droitwich District. 100 waters; 23 good.				
Lowest	36	1·5	·00	·07
Highest	261	52·5	1·13	·90
Average	73	18·	·13	·20
Dudley. 7 waters; 2 good.				
Lowest	28	2·7	·00	·08
Highest	143	33·	·48	·36
Average	87·8	13·6	·19	·19
Coventry. 10 waters; 3 good.				
Lowest	32	1·9	·02	·02
Highest	134	9·2	1·60	1·22
Average	64·3	6·1	3·72	2·03
Nuneaton. 15 waters; 7 good.				
Lowest	21	1·6	·01	·02
Highest	119	14·5	·56	.20
Average	46·4	6·2	·13	·07

WATER ANALYSIS.

Worcestershire.				
Normal	63	2·5	·02	·08
Polluted	64	8·0	·00	·16
Warwickshire.				
Normal	35	2·8	·00	·07
Polluted	166	16·0	·08	·13
Radnorshire.				
Normal	11	0·7	·00	·04
Polluted	22	1·5	·06	·10
Lancashire.				
Normal	10	0·6	·00	·02
Polluted	13	0·9	·01	·08
Pembrokeshire.				
Normal	10	1·8	·00	·01
Polluted	14	2·5	·04	·09

In these Tables we shall see that there is a considerable difficulty in using a hard-and-fast line in the interpretation of results. Prof. Parkes states that the total solids of a wholesome water should not exceed 8 grains per gallon, unless in the chalk, when he allows 14 grains. Dr. Wilson, in his well-known handbook of

Hygiene, allows 30 grains; whilst Mr. Wanklyn does not condemn a water in which the solids do not exceed 40 grains in the gallon. Now, in the first Table, there are very few waters out of 232 samples that give as low an amount of solid as even 40 grains per gallon; there are waters of surface wells in the new red sandstone containing frequently large amounts of lime salts, especially of sulphate of lime, and chlorides in excess. Were they to be condemned for this fault only, where should the inhabitants obtain their water from? I certainly do not think such waters of a high class of wholesomeness; they are very hard, but independently of this, some are largely polluted with organic matter, in consequence of which, most of these wells are now closed and a town supply of good water substituted. In Leamington nearly all these wells are closed, and a deep Artesian well substituted; the same may be said of Coventry. In the urban district of Droitwich, a new supply from a pebble drift under the marls, giving a water of a high degree of purity, has just been opened.

The chlorine has frequently been supposed to be indicative *per se* of sewage contamination, but in the first Table the chlorine is for the most part excessively high, and yet 65 of these waters are uncontaminated. The new red sandstone being a salt-bearing stratum, on the other hand, in the second Table, some of the waters not exceeding 2·5 grs. of chlorine to the gallon, have been directly polluted with typhoid excreta. The ammonia, especially albuminoid, will also be found to present much the same results. Mr. Wanklyn states that water from ·05-·10 of albuminoid ammonia in the million parts is a safe water, from ·10 upwards dirty and suspicious, but the water should be absolutely condemned if it reaches ·15. I agree with the latter sentence, but the *safe* waters I think are often open to grave suspicion. The second Table is drawn up to show that no hard-and-fast line can be entirely depended on in interpreting the Sanitary value of the amount of albuminoid ammonia. I have, in various counties, contrasted the amount of albuminoid ammonia which has appeared to me to be normal with that obtained from a water which I have reported as polluted. In Worcestershire and Warwickshire I have taken wells in which, although there is undoubted pollution, no illness has resulted from the use of the water; whereas in Radnorshire, Lancashire, and Pembrokeshire I have contrasted the normal water with that of a well which has been the direct cause of an outbreak of typhoid; that in Radnorshire, remarkable as a well apparently removed from all sources of pollution, was evidently the cause of a severe and fatal outbreak of typhoid, inspection showed it was contaminated by the overflow of a brook during flood, into which, at two miles' distance, typhoid excreta had been freely thrown. Now, in these three examples the albuminoid ammonia was only ·10, ·08, ·09; so that at the most they would only have been considered suspicious, and most probably been reported wholesome. This was certainly the case in the Pembrokeshire well, which in three analyses was reported to be a good water. All these analyses have been made of wells I have personally inspected, and seen the

source of pollution. By contrasting the analytical result with the normal water, the extra amount of albuminoid is much the same as in the cases alluded to in Warwickshire and Worcestershire.

Warwickshire .		Normal Albuminoid .	·08
·08 + ·08	=	Polluted Well . .	·16
Worcestershire .		Normal	·07
·07 + ·06	=	Polluted	·13
Radnorshire . .		Normal	·04
·04 + ·06	=	Polluted	·10
Lancashire . .		Normal	·02
·02 + ·07	=	Polluted	·09
Pembrokeshire .		Normal	·01
·01 + ·08	=	Polluted	·09

The two former wells being in porous strata, the three latter in a hard impermeable stone. I think these examples will show the value of actual inspection of the water, or at any rate of reliable information as to its surroundings, and of obtaining, if possible, a knowledge of the normal condition of the water of the district. The free ammonia also must not always be referred to sewage. In the mineral springs of Radnorshire and Brecon I have found a large quantity of free ammonia under surroundings that preclude any suspicion of contamination. The fact is, that this ammonia occurs from volcanic action, the mineral springs arising from the contact of trap rocks with the slate and the decomposition of sedimentary deposits.

Deep wells also contain nitrates, especially in the chalk where the previous sewage contamination is certainly prehistoric. The moist combustion process also gives us curious information at times. I recently examined a well-water which gave as much as 72·5 milligrammes of oxygen to oxidize the organic matter in a litre; this water was polluted as well with nitrogenous matter; this great amount on inspection of the well proved due to the decay of an old wooden pump in the well—ordinary polluted waters requiring from 5 to 7 parts per million of oxygen. Another water under similar circumstances required 62·5 of oxygen to the litre.

I think the knowledge of the surroundings of a water so important that in my own district I have supplied the inspectors with the following label, taken from a form prepared by Dr. Cornelius Fox:—

DROITWICH RURAL SANITARY DISTRICT.

Sample for Analysis.

Date of Collection . . .
Source . . . . . .
Depth of well . . . . .
Nature of soil . . . . .
Distance from nearest source of pollution . . . . . .
Why complained of . . . .

Many people think that by withholding information they will get what they call an independent opinion. This is quite right in the analysis of adulteration of food, but with water the more information given to the analyst the more reliable will be the opinion given.

Time does not allow me to touch upon the microscopical appearance of the deposit. The value of this must be apparent to everyone; but it is not easy to give all the information we may wish in the short space of twenty minutes the Congress allow for a paper. I have endeavoured to avoid partizanship and to give every analyst his fair due—I only trust that in my desire to be as concise as possible, I have made the matter sufficiently clear to you.

HORACE SWETE, M.D. (C.S.S CAMB.).

Professor WANKLYN expressed his satisfaction with the papers, and entered into some scientific details. He congratulated Dr. Swete on the results he had obtained. He said the objection raised to his process, that it did not account for all the nitrogen, was based upon a misconception. He then explained what changes took place.

Dr. STRONG mentioned that at a public institution with which he was connected an outbreak of diarrhœa occurred, and it was very difficult to trace it to its source. Eventually, however, he found there were some wells which had been used to collect the rain-water from the roofs. He therefore had the wells cleaned out, and ordered that the water should be used only for washing purposes. Well, later on diarrhœa broke out again, and he found that one old gentleman had persisted in drinking the water because he said it made the best tea. As the only method of getting rid of the danger, he (Dr. Strong) had now ordered the wells to be filled.

A MEMBER OF CONGRESS—Did the old gentleman who drank the water have the diarrhœa?

Dr. STRONG—Yes.

The MEMBER—Was he the only one?

Dr. STRONG—No. I found others had drunk the water besides him, but he was a particularly obstinate old man, and would probably have preferred to have the diarrhœa, to giving up his good tea.

Dr. TATHAM (Salford) asked if any evils had been traced to the use of neglected filters.

Dr. JACOB (Redhill) make some remarks on a recent outbreak of typhoid, caused by water supplied by the Caterham Water Company.

After some remarks from other gentlemen,

Dr. CARPENTER said that as long as a water supply was pronounced pure by the chemist and microscopist, those who had that supply might drink it safe from the chance of producing disease in their system as an epidemic. He was not speaking of cases now arising now and then, because he believed a very few of the disease-producing particles would induce disease if swallowed by persons

susceptible of it, but if there were sufficient particles to produce an epidemic the chemist was certain to discover it.

Professor DE CHAUMONT, in the course of his reply, said he had certainly known bad results to follow from the use of neglected filters. The charcoal became clogged with organic matter and after a time turned out to be a source of injury instead of benefit. In his opinion filters unless frequently cleansed did more harm than good.

Dr. SWETE, in his reply, said there was no simple popular test of water which he could recommend. He believed, however, that the difference between animal and vegetable pollution could be detected so freely as to suggest fuller examination. The only safe plan was to have a complete chemical analysis.

Preventable Mortality. The Mortality from Alcohol.

TILL about two years ago I laboured under the impression that the statement, that 60,000 victims to intemperance died every year in the United Kingdom, was a wild and unwarrantable exaggeration. But on applying my own medical experience with that of several medical friends, to the total number of practitioners in three kingdoms, I was most reluctantly forced to confess that by no reasonable reckoning could I estimate our annual mortality from intemperance in alcohol at less than 120,000 souls, of whom 40,500 succumb through their own personal indulgence, and 79,500 through poverty, disease, accident, or violence springing from the indulgence of others. This estimate has been widely and fully criticized all over the country, but its accuracy has not yet, I regret to say, been questioned; many high authorities such as Dr. Hardwicke, Coroner for Central Middlesex, and many well-known Medical Officers of Health having pronounced it "extremely moderate" and "far under the truth."

This computation was based on the number of medical men in practice being assumed to be 16,000; but, from an undertaking recently completed, I find that the actual number is a little more than 18,000. The same ratio as before applied to 18,000, the true number, instead of 16,000, the supposed number, would give an annual mortality of 134,499, of which 45,562 would die from personal intemperance, and 89,437 from the consequences of intemperance of others.

The calculations of Dr. Thomas Morton point to a mortality of fully 60,000, whilst the late Dr. Lankester estimated the deaths due to excess in drink as 67,000 in 1877. My own practice during the last twelve months indicates (with every possible deduction) a mortality of 57,600.

The annual rate of mortality per 1000 between the ages of twenty-five and sixty-five among clergymen is 11·7, while among publicans, beer-sellers, and wine and spirit merchants, it is 26·64.

It may be objected by those unacquainted with the facts that, in the Registrar-General's Fortieth Report, only 1146 persons appear as having died from alcohol in 1877 in England and Wales. All who are familiar with the subject know that the Registration Returns are no criterion whatever of the prevalence of drunkenness as a prime factor in the causation of death. In the present certificates of death medical practitioners are called upon only to state the disease from which death occurs, and are not asked what has caused the disease. Of the many members of the profession whom I know, not one ever hints at alcohol in the death certificate, unless in those cases in which the name of the fatal disease, such as delirium tremens, in itself is an evidence of the operation of this narcotic poison. Our death certificates are not at present liable to publicity, and the proclamation to the sorrowing survivors and to an inquisitive public of the secret drunkenness of some loved and respected deceased, would but ruthlessly harrow the feelings of the former and pander to the idle curiosity of the latter. Were, however, all deaths certified by some medical expert, independent of private practice altogether, or were the history of the origin of the disease that has cut short the life treated as a confidential report for purposes of Public Health, we should arrive at a much closer approximation to the actual causes of preventable mortality than we have any possibility of doing at present.

So much for the mortality from the intemperance of the slain by alcohol. But the preventable mortality from drinking embraces a much wider range. For every one whose life is shortened by his own immoderate indulgence in drink, probably at least two innocent lives are sacrificed.

Children are killed by suffocation through the drunkenness of their parents; both mothers and infants die for want of proper sustenance and decent clothing and shelter on account of the head of the family wasting his money in drink; and numerous violent deaths are due to drunkenness. Mr. Payne, the coroner, remarks that "if it were not for the drink, the services of a coroner's jury would be but seldom required."

The influence of alcoholic indulgence in the death-rate was well illustrated in the city of Glasgow towards the end of the first quarter of the present century. In 1821 the number of deaths, from Cleland's Tables, was 3686 and in 1822 was 3690; but in 1823, when the reduced duties on distilled spirits began to operate, the mortality rose to 4627, and in 1824 to 4670.

The sway exercised by alcohol on the rate of mortality is clearly shown in the following Table extracted from the Fortieth Report of the Registrar-General.

Mean Annual Rate of Mortality in England from each Class of Causes for two Quinquennials, 1865-74; *also Rate of Mortality in the years* 1875, 1876, *and* 1877.

Classes.	Causes of Death	Annual Deaths to 1,000,000 Living.				
		5 Years 1865-69.	5 Years 1870-74.	Year 1875.	Year 1876.	Year 1877.
I.	Zymotic Diseases	5171·8	4849·2	4473	4005	3559
II.	Constitutional ,,	4154·4	3777·6	3775	3627	3613
III.	Local ,,	8887·2	9165·6	10373	9505	9450
IV.	Developmental ,,	3605·0	3367·4	3290	3045	2940
V.	Violent Deaths	797·4	751·6	793	762	723

From this Table it will be seen that in every Class save one the mortality has steadily and remarkably diminished; but in Class III the mortality has, up till the year 1876, as steadily and markedly increased. In this Class the principal increase has been in deaths from diseases of the brain and nervous system, of the organs of circulation, of the respiratory organs, of the liver, and of the kidneys. These are precisely the organs most apt to be seriously affected by excess in alcohol; and it is a significant fact that since the diminished consumption of intoxicants, from the combined influence of the pressure of hard times and the rapid spread of temperance principles, beginning with the year 1876, there has been a decrease each year in Class III.

I prefer to limit the present inquiry to the influence of the excessive use of alcoholics on the mortality, inasmuch as this is a department of the investigation in which we can all work. This paper has reference, then, to deaths from immoderate drinking alone.

Is there any possibility of arriving at the truth, and if so, what is the most accurate method of inquiry? We can never hope to trace out the whole deaths occasioned by alcoholic excess, as secret inebriates almost invariably conceal and deny their besetting sin, and the period of medical attendance is often too brief for the detection of the truth. But there is no reason why we should not be able to come at the greater part of the actual mortality. We who have hitherto essayed to methodically investigate this important question are too few (but two attempts having as yet been made on a scientific basis), to warrant the application of the results of our inquiries to the entire death-roll of the country; but if 500 medical men in active practice, in different parts of the kingdom, some in city some in country practice, were to keep an accurate record of the causes of all deaths occurring in their practices for a specified period of twelve months, the ratio so obtained might be applied both to the total number of deaths and to the total number of medical practitioners.

Let the true fatality from alcohol be what it may, it is wholly unnecessary. The use of intoxicating liquors, as beverages, is indispensable neither to our existence nor to our happiness. We are surely ever open to sufficient and unavoidable dangers to persons and to life, without cherishing at our domestic hearths and honouring in our most sacred festivals so poisonous and deadly an article, manufactured by human ingenuity, at the expense of the destruction of enormous quantities of the food supply so essential to the preservation of the Public Health. The enlightenment of the public mind on the fearful amount of preventable disease and death wrought by the ravages of alcohol is an appropriate mission for a Sanitary Congress, and will greatly aid in arousing that popular sentiment which alone can effectually stamp out this easily preventable mortality by the social ostracism of the offending artificial poison and the speedy enactment of efficient prohibitory legislation.

NORMAN KERR, M.D., F.L.S.

The Relation of Alcohol to Bad Sanitation.

IT has been frequently alleged that bad sanitation is one of the chief causes of intoxication which so largely prevails in this country. There can be no doubt, I think, but that insanitary conditions of life do in many cases lead people to resort to alcoholic liquors, but we underrate the wonderful difference which is occasioned by time and habit. The following fact will illustrate this.

The Corporation of London has a considerable amount of property near Londonderry, consisting mainly of land upon which small cabins are built, tenanted by farm-labourers. On account of certain representations made to the Corporation, a deputation was sent to see whether these dwellings were fit for human habitation. They were found to be wretched hovels unfit for human habitation, and orders were given that new, commodious and well-ventilated cottages should be built. [Photographs were exhibited.]

On the occasion of their next visit they asked their tenants if they liked their new homes, and several at once replied that they did not like them at all, and "might they go back to the old ones." "What was it they did not like?" "Well they were not used to going upstairs to bed, and it was so cold without the pig." It was ultimately found absolutely necessary to pull down the old shanties if the new commodious cottages were to be used, and this was finally done, to the great annoyance of the peasants.

If good sanitation were an efficient preventative of intoxication there ought to be very little in healthy homes. I need hardly say that we are disagreeably disappointed here. Further, I have made

inquiries among the blocks of model dwellings erected in various parts of London, and I find that, on the average, four per cent. of the adult population are notoriously addicted to the excessive use of alcohol.

That the employment of alcohol as a habitual beverage, other things being equal, increases the susceptibility to disease, and its total amount and duration, is shown by the following facts:—

1. It has been repeatedly observed that when epidemics of such diseases as cholera and yellow fever have been prevalent, those who are known to be drunkards are much more readily attacked, and far more frequently succumb, than the general population.

2. The London Grand Division of the Friendly Society known as the Sons of Temperance is composed of working men of all trades save those connected with liquor. During the seven years, 1871-8, there were, on the average, about 1200 members. During those years there were 5 days of sickness for every member in each year. In contrast with this we find the Manchester Unity of Oddfellows averaging 7.7 days per member. This contrast would be even greater could we eliminate the reformed drunkards from the Sons of Temperance and the teetotalers from the Oddfellows.

3. Dr. W. B. Carpenter some years ago adduced the Government returns of the sickness of the European troops of the Madras Army for the year 1849, in which the men were classed as total abstainers, temperate, and intemperate: these showed that the relative proportion of those three classes admitted into hospital for disease was 130, 141, and 214 respectively, and the mortality as 11, 23, and 44. Later statistics fully corroborate these results.*

That alcohol should tend, when imbibed, to increase the liability to disease is not to be wondered at when we reflect that it acts in direct opposition to the recognized object of all good sanitation. The great end of Sanitary Science is to secure the removal in the speediest possible way of the effete products of vegetable and animal life. The great natural means for this end is *oxidation*. The effect of alcohol in the system is to check oxidation.

That alcohol is prejudicial to all growth and development—that is, to healthy life—may be shown by a simple experiment. If the seed of cress be sprinkled on earth in separate pots, or on flannel, and watered every day with pure water in one case, and with water containing respectively $\frac{1}{2}$, 1, $2\frac{1}{2}$, 5, and 10 per cent. of alcohol (rectified spirit), it will be found that even the weakest of these alcoholic liquids exercises a marked deterring effect on the growth of the cress; the 10 per cent. solution just permits the seed to swell and in some cases to sprout a little, but, if continued, finally kills the seed; the others exert a malign influence in proportion to their strength, the 5 per cent. just permitting growth in a feeble and etiolated condition. By simply covering the growing seed with a glass cover, so arranged that the condensed alcohol and water ran back to the seed, I find that water containing only $\frac{1}{2}$ per cent.

* Annual Report of the Soldiers' Total Abstinence Association for the year 1877-78.

of alcohol thus continuously operating produced as great a detrimental effect as water containing 5 per cent. applied intermittently; and that ¼ per cent. of alcohol, ⅛ per cent., and even $\frac{1}{16}$ per cent., all hindered growth in exact proportion to their alcoholic strength. [Specimens were shown.]

It is unnecessary to specify the diseases which are frequently caused by alcohol. I would rather insist on the influence it has in rendering disease more frequent, more persistent, and more fatal. If required to state the least quantity which would be thus injurious, I must acknowledge myself unable to do so. But, as sane Sanitary reformers, we are always advising the people to adopt the best possible Sanitary arrangements, and I do not think any of us would recommend men to be satisfied with a very slight amount of atmospheric impurity or of sewage pollution, where pure air and pure water were easily obtained, or the impurities easily avoided. On this ground it seems to me advisable to urge on healthy human beings the strictest avoidance of such an anti-Sanitary agent as alcohol.

J. James Ridge M.D.

On the Importance of Thorough Ventilation in Dwellings.

The importance of efficient ventilation of our dwellings has been so often insisted upon, and the subject of ventilation itself so frequently written about, that I hardly know what apology to offer for my appearance before you to-day; yet when we consider the sums that have been spent, the volumes that have appeared from time to time, and remember that the whole question as to the proper method of ventilation is still one which is in its infancy—I might say unborn, inasmuch as the best method of conveying fresh air to an apartment and modifying the supply according to the number of individuals present, is still undiscovered—my remarks may not appear inopportune.

I have no new scheme to offer, have invented no machinery or apparatus: I propose to consider only the means which are open to all, whether inhabiting the cottage or the mansion, and to lay down certain broad principles which each one may act for himself. I shall therefore speak—

1st, Of the theory of good ventilation;
2ndly, The effects of bad ventilation;
3rdly, How best to secure it when deficient or defective.

Now what do I mean by the theory of ventilation? I came across a passage in a paper—by, I think, Mr. Crookes—some time ago which struck me very forcibly at the time, viz: "That no disease can be thoroughly cured when there is a want of proper

ventilation." But though this is an important reason for attention to the subject, there is one still more urgent, even life itself; for without a constant supply of fresh air to the lungs, the blood cannot be properly oxygenated, and changes occur which will be better dealt with later on.

A few remarks on respiration are a necessary preliminary to our subject.

As you all know, the air which is inhaled loses a certain quantity of its oxygen in passing through the lungs, and the exhaled air contains an increased amount of carbonic acid.

This carbonic acid rapidly renders the air unfit for respiration; in fact, when it reaches the proportion of six parts in 10,000 of air, according to experiments made by Professor de Chaumont, one of the Council of the Sanitary Institute, organic impurities become perceptible. Calculating from the number of inspirations per minute, and the percentage of CO^2 contained in the expired air, it is found that each individual renders 3000 cubic feet of air impure in the space of an hour.

The problem which ventilation is called upon to perform, is to introduce a constant supply of pure atmospheric air, without causing inconvenience as to temperature or draughts, and the amount of air necessary to keep the standard of ·6 is well shown in this diagram, drawn out by the late Professor Parkes. He also shows that when the amount of CO^2 exceeds the standard of ·6, the air becomes close and then decidedly unpleasant. At the House of Commons a minimum of thirty feet per minute is allowed, increased to sixty feet, as occasion may require.

Now an ordinary candle acts in the same way as a human being, both consuming the oxygen which sustains life and both giving out the CO^2. If the candle be placed under a large bell-glass, the light will gradually grow dim and finally go out, the oxygen has been consumed, burnt up, and the candle is extinguished by the CO^2. Now tilt up the bell-glass a little, the CO^2 being heavier than the atmospheric air will fall to the bottom and be forced out below by the entering pure air.

If I had two tumblers, one with a small light burning in it, and the other tumbler filled with the CO^2, I could pour the gas from the one vessel to the other and the light would at once be extinguished. The same effect would be produced if oxygen were drawn out by means of the air-pump.

What, then, is thorough ventilation? A supply of pure atmospheric air in sufficient quantity to neutralize gases derived either from the breath of individuals—combustion of various kinds—or foul exhalations from extraneous sources; as soon as the equilibrium between supply and demand of fresh air is disturbed, and the balance is on the wrong side, then we get deficient ventilation.

How often do we see a large room in a house replete with every comfort and commodious, a large chandelier with several gas-burners suspended from the ceiling and perhaps a dozen persons occupying the room. There is at first plenty of air, but when the

gas is lighted circumstances are widely different. We have—say, five jets, each burning three to five cubic feet of gas per hour; now each of these jets will consume as much of the oxygen of the air as five persons; multiply this by five, will give an equivalent of twenty to twenty-five persons and with the ten actually present thirty-five. Now imagine what must happen—a feeling of languor, lassitude, and weariness comes over the visitors, each one in turn begins to yawn and a general feeling of *malaise* supervenes, then headache.

What do we find every Sunday evening at church?

It frequently happens that from motives of convenience gas is used to warm the building; it is therefore lighted some time before commencing service. On our first entering the church the air strikes hot and unpleasant, but we soon get accustomed to it and feel tolerably comfortable, till that painful feeling of drowsiness comes on which I am sure everyone here has felt several times in his life. This is generally put down to the quality of the sermon, but the preacher is unduly blamed; it would have been the same had he the oratory of Demosthenes, the fault is elsewhere.

I do not believe there is a place of worship in the kingdom which is properly ventilated; our public places of amusement, our courts of justice are just the same.

If we were asked to sit side by side with two men just fresh from some noxious or unwholesome employment, many would hesitate, yet we perhaps sit for hours in a crowded room with a far worse state of things.

A number of persons congregated together with foul breath, some not over-clean in their persons or their garments, perhaps suffering from disease; we instinctively shun the dirty garments, but breathe that which is much worse deleterious and loathsome.

This is the age for education, and Board schools with handsome exteriors are rising everywhere, but is the same care taken of the interiors, that the proper cubic space required for each child is provided? Many children, especially in very poor neighbourhoods, are not so cleanly either in their persons or garments, and it is the highest degree incumbent upon our School Board that they should carefully see that the cubic space necessary is secured, and that there should be the means at hand for the whole atmosphere to be constantly changed. In large schools I would have every window opened by an arrangement similar to that provided in a greenhouse, where by moving a lever the whole of the lights can be opened at one time. Now if this could be done, and the room cleared of children in the middle of the morning and afternoon, there would be a considerable gain to the teacher and the taught, many impositions would be saved, and the child would learn much more readily.

Bedrooms: how important that these should be well ventilated. During sleep the nervous power is exhausted; it is essentially a period of reparation when oxygen is being stored up for use later on. Less CO^2 is given off during sleep than when awake, and it is well that it should be so; for if a person under ordinary circumstances were enclosed in a room eight feet square, all excess of fresh air being excluded, he would be moribund in twenty-four hours.

We often hear, "I would not sleep in a room without a fireplace on any consideration," and yet how frequently is the fireplace stopped up by a board or the register down. I am often told, "But I sleep with the bedroom door open." Now there cannot be a greater mistake than trusting to this alone; it is of course better than having it shut, but unless there is an outlet for the foul air there can be no inlet for pure air. A room will only hold a certain number of cubic feet of air, and this cannot be displaced unless there is pressure or a current from without. I was gravely told the other day by a man of no mean attainments (and to whom I pointed out that the register of the stove in his bedroom was closed, and his room very ill-ventilated and unpleasant), that he was a bad sleeper and he knew he slept better when his room was close! What more fruitful source of consumption is there than sleeping in a small ill-ventilated and perhaps crowded bedroom? Our barracks and men-of-war have demonstrated this.

Lately attention has been drawn to the condition of the bargemen on our canals, and it would be as well if our legislators could attack the travelling vans which frequent fairs, &c., often inhabited by a family, when there is less cubic space than is required for one person.

Many offices in London where the buildings are crowded closely together and lit up by gas are very unhealthy, and employers would do well to pay more attention to their ventilation. Our railway carriages, as a familiar illustration, require better ventilation. If you are travelling a few miles without a stoppage in a carriage three parts full, how many of the passengers have taken a nap before arriving at their destination. All these are examples of the effects of CO^2 on the system.

We will now consider the third point,

How best to secure it (good ventilation) when deficient or defective.

When I first commenced writing this paper I was anxious to measure the velocity of various currents by an air meter, and I was unaware that there existed such a beautiful little instrument as the one I have before me, constructed by Mr. Casella for the late Professor Parkes—one who will always be remembered with gratitude by all workers in Sanitary Science as the author of the most valuable work on Hygiene we at present possess.

With this air meter I made a few experiments in different sized bedrooms, and with the doors in different positions, which demonstrated that whether the room door was closed or open there was always a current of air with varying velocity up the chimney, averaging 1 to 1½ miles per hour; for instance, at midnight on Saturday last the air meter stood at 173,740, and at 8 o'clock on Sunday morning the reading was 209,708, showing a difference of 35,968, to which 14,400, the correction to be applied to this particular air meter for that period has to be added; giving a total

of 50,368 as the number of feet of air which an ordinary register stove passed through her aperture in eight hours, or a column of air nearly a mile and a quarter in length per hour. The day previously gave also about 1¼ mile.

A similar experiment two days earlier, the rate at which the air was passing gave almost exactly one mile per hour.

In a dining-room with two gas-burners, the fire nearly out and the door closed, the velocity was increased three-fold, but when the door was widely opened and cold fresh air was drawn in from the passage, as the air in the chimney became more cool, notwithstanding the extra draught, each experiment showed a gradually decreasing velocity. I mentioned at the commencement that I had no new apparatus to describe, I have therefore carefully avoided mentioning the numerous ventilators which have been advocated from time to time. Some are ineffective, some costly, others are only useful under particular conditions, whilst many, though they allow the ingress of pure air, do not so direct the current as to provide that the cool fresh air from without shall mix with the heated atmosphere of the room and the occupants not be exposed to a draught.

To epitomize: to have thorough ventilation, the air in an apartment must be frequently changed, to effect which there should be a communication with the external atmosphere. The foul air whether caused by combustion, the CO^2 derived from the breath of persons present, or from noxious effluvia, must be got rid of; and as the result of the few experiments I have made and other observations, I consider that under ordinary conditions there is no better ventilator, more especially if assisted by a fire, than the ordinary chimney. Some means should, however, be devised for getting rid of the products of combustion derived from burning gas. I think it is more especially under the latter condition that mechanical contrivances are demanded.

I may add, in conclusion, that in registering with the air meter the results were carefully noted, but I do not pretend that they were done with strictly scientific accuracy, at the same time they were verified by my friend Mr. Cushing, who was kind enough to assist me in the matter.

H. J. Strong, M.D.

Infant Mortality.

It is the object of this paper to bring to the notice of the public a few points having an interesting connection with the annual rate of infant mortality.

To justify myself in thus taking up valuable time I need only point out the high rate of mortality in the first year of life.

In 1877, 451,896 male children were born and 67,616 died under the age of one year, or about 15 per cent.

In the same year, 436,304 female children were born and 53,201 died under one year old, or about 12 per cent.

In the first case, the deaths of the male infants represented 25 per cent. of the whole mortality occurring among males, which was 260,567.

And in the second case, the deaths of the female infants represented 22·17 per cent. of the whole mortality among females, the latter being 239,929.

Having shown the mortality among infants to be frightfully great, I shall now proceed to point out three causes which, in my humble opinion, conduce to this result. But I would first wish to state that my experience, such as it is, has been gained from medical practice among the lower and middle classes of this town and South London.

Cause 1st.—Deficiency in quality or quantity or unsuitability of nourishment given to infants.

The lower and middle classes as a rule suckle their infants, but unfortunately they also feed them by means of the bottle or spoon.

This is done generally for one or two reasons—

(1) Either they are led by the baby's constant fretfulness or constant hunger, due often to indigestion, to think that their breast milk is not sufficiently nourishing or satisfying; (2) or, they feed them to provide nourishment for their infant during their absence, often for many hours daily, at work or elsewhere.

The first reason prevails very much among the poorer classes, who seem to ignore the fact that breast-milk was provided for the nourishment of their offspring. And so many patent foods are now advertised and puffed, that the opinion seems to grow daily in the public mind that they are always thoroughly essential to the welfare of infantile stomachs.

I do not wish for one moment to condemn these preparations as useless, but being often too expensive for the lower classes to buy, the latter generally use a bad substitute as gruel, bread or biscuit sop.

According to my daily experience, most mothers among the poor go out to work of some shape or other, consequently the care of the home and the babies is generally left to other persons, often young children.

In some instances the babies are taken to a *crèche* or infant nursery, where of course they must be fed by hand. It is far from my intention to speak against such useful institutions, but I think their utility should be limited to the infants of widows or women with sick husbands; such is, however, not always the case.

When infants are fed it is generally with bread or biscuit sop, in fact with some farinaceous preparation they cannot digest.

This is often given from the birth, and cannot then be digested owing to the absence of the salivary and pancreatic secretions, which are required for the necessary conversion of the starch contained in farinaceous food into dextrine and grape sugar, previous to its absorption into the system. I will quote from

Dr. Eustace Smith, a great authority upon the diseases of children.

In his excellent work on the wasting diseases of children, he states, that the salivary secretion in the child is not fully established until the fourth month.

He also refers to the experiments of Professor Korowin, of St. Petersburg, which show the secretion of the pancreatic gland in the second month of life to be very scanty, and to have little action upon starch.

The undigested food in the bowels of the infant sets up acid indigestion, and causes a disagreement of the whole alimentary canal.

By its irritation it acts reflexly upon the brain, and often brings on convulsions, one of the many diseases by which infant life is lost.

And that is not the only evil; in addition, the baby is more or less starved.

The food being undigested, its nutritive properties are not assimilated and the system derives no support from it.

I think it cannot be too strongly insisted upon that every mother should suckle her infant and not feed it at all for the first nine months, unless medical advice has urged a contrary course.

I admit that there are many cases where a mother would do well to abstain from suckling her child, but it should always be only under medical advice; and if this rule was always carried out, I am sure the lives of many infants would be spared.

Now many women, either from ignorance of the harm they are doing, or from a wish to be spared a further increase in their family, suckle their children too long, sometimes until the babies are fifteen and eighteen months, or even two years old.

The first effect of this unnatural prolongation is that the mother loses her health and strength, which causes her milk to become thin and poor, showing a deficiency of casein and butter, its nutritive properties.

Then the child in its turn suffers, becoming also emaciated and weak; from a fat healthy looking baby with firm flesh it soon dwindles away to a thin, haggard, flabby pigmy, in fact it is half starved. In this state it is strongly predisposed to catch any of the common ailments of children, as measles, scarlatina, whooping cough, and the like.

The ordinary dentition troubles are also greatly increased, and very often infants in such a condition ultimately die from one of these complaints.

Hence I maintain that the annual reports of the Registrar-General, in which the causes of death are classed under five heads—"zymotic, constitutional, local, developmental, and violent," are in a certain measure misleading; for if the infants were not greatly reduced in strength and almost at death's door from scanty or improper nourishment, they would not so frequently succumb to those diseases, which in the upper classes do not make such fearful ravages.

It is often my lot to see such children apparently waiting for some disease to come and carry them off. I have always found it

a most difficult task to persuade mothers that breast-milk after the ninth month is improper nourishment for their infant. On the contrary, they seem to think that the more weak and ill an infant is, the greater necessity for strict adherence to breast-milk only.

Even when the mothers themselves are ill, they cannot be brought to see that their milk must suffer in quality and quantity, although they would not buy milk drawn from a diseased cow.

I can only hope that this state of ignorance amongst mothers, which is the chief cause of the evils to which I have referred, may be remedied in the future by means of suitable education, which subject I must leave in the hands of other and more competent men than myself. Then and then only will the rate of mortality of infants be sensibly reduced, and the ravages of the zymotic diseases much decreased.

Cause 2nd.—Want of medical assistance at childbirth and during the lying-in state.

This is a minor one in comparison with the first, but still it has some effect on infant mortality.

Owing to the small earnings of the agricultural and other labourers of this town, the high rents and dearness of provision on the one hand, and on the other to the rules of the Local Government Board, or the way in which they are applied by the relieving officers, many of the wives of our poorest inhabitants are without medical attendance in childbirth.

At that critical time they receive only the assistance of some unskilled woman—a laundress, charwoman, or monthly nurse of a low type.

As far as I know, there is only one certified midwife in this large town, and many of the women who attend confinements are dirty and ignorant in the extreme; in fact, I can confidently state that the stock on a farm and the mares in a stable often receive more skilled attention than some of our poverty-stricken fellow-creatures.

The way in which this want of proper assistance affects the mortality rate is as follows:—

The function of respiration is sometimes not properly instituted, owing to the lungs not being thoroughly inflated with air immediately after birth takes place, and the infant dies after a few days of collapse of the lungs, to which disease is perhaps added a low form of inflammation induced by the same.

Feeding with farinaceous or other thin improper food is constantly recommended by the so-called midwives, and has been shown to be a fruitful source of loss of life. But deficiency of suitable clothing is still more often a cause of disease (as far as I have seen, the same amount is given to the infant in all seasons of the year). This want of sufficient warm clothing acts most prejudicially upon those infants which, having been born prematurely, are very thin and wanting in vital power. Low temperature causes them great suffering, and they are often quietly allowed to die by parents imbued with the prejudice that a seventh or eighth month child cannot be reared.

Cause 3*rd*—Is failure of coroners to hold inquiries and take medical evidence in every case of death occurring to infants which have not been attended by a medical man. That such is the case I need bring no evidence to prove, it is a well-known fact.

I remember well a case occurring in this town, when an infant was suckled one morning at three o'clock, and found dead three hours later at the mother's side. The child had not been ill, in fact was strong enough to draw the milk from its mother's breast.

An inquest was certainly held in this particular case, but no medical evidence called nor a *post mortem* examination made.

I do not wish even to hint that the child was poisoned, but if it had been dosed with paregoric, which contains opium, no one would have been any the wiser.

I believe that the dread of an inquest and *post mortem* examination has a salutary effect upon people who are careless of the lives of infants, or wish to get rid of them for the sake of gain.

That such an unnatural desire sometimes exists, the police reports can amply testify.

Cases have occurred in my experience, when I have suspected a desire for the death of the sick infant to whom I have been called in, apparently at the last moment, for the sake of procuring a death-certificate. On such occasions I always threaten a refusal to certify and hint at the necessity of an inquest, the result being more than once a speedy recovery of the child to health. Whether the failure of the coroners to hold an inquest and call medical evidence upon every certified death arises from a wish to save themselves trouble or the county rates a few pounds, I do not pretend to say; but I maintain that the present uncertainty of the coroners' action robs us of that salutary fear which would tend to make evil-disposed persons very careful of taking away the lives of their offspring or of children intrusted to their care.

In conclusion, I trust that the account given of the three causes which, in my opinion, help to increase the rate of infant mortality, has proved sufficiently interesting to you, to justify me in taking up your valuable time.

F. Nichols.

On Common Lodging-House Accommodation.

If there be a single individual in whose well-being all concerned in the maintenance of public health should take a special interest, it is the poor traveller. Nor is this unrecognized. So long ago as 1848 the State realized that to neglect the poor traveller and his environment was to imperil the health of the community; and

accordingly in the Act for Promoting the Public Health, passed in that year, local boards were required to register common lodging-houses and to make bye-laws fixing the number of lodgers that may be received, for promoting cleanliness and ventilation, and with respect to inspection. Again, in 1851, it appeared to the Legislature that "it would tend greatly to the comfort and welfare of many of Her Majesty's poorer subjects, if provision were made for the well-ordering of common lodging-houses," and the Act of 1851 was passed. But except that it empowered local authorities to make bye-laws in the interests of morality,* as well as health, little was effected by this measure. After some experience of the working of these provisions, it must have been found that lodging-houses and their keepers were still not quite what it was desired to have them, and in 1853 common lodging-houses were once more the subject of a special Act. It was now required that every common lodging-house be "inspected and approved for that purpose by some officer appointed in that behalf;" and permission was given to the local authority to "refuse to register as the keeper of a common lodging-house a person who does not produce a certificate of character," signed by three inhabitant householders. By the Act of 1851 a keeper was required to advise his authority when a lodger became ill with an infectious disease, but by the amending Act the authority was for the first time empowered to remove such lodger, and disinfect or destroy any bedding or clothes used by him. The Acts passed in 1853 also required the keeper of a common lodging-house to thoroughly cleanse it in accordance with any regulations or bye-laws of the local authority, and to the like satisfaction limewash the walls and ceilings thereof in the first week of April and October in every year.

Section 35 of the Sanitary Act, 1866, contains provisions by which a Secretary of State may on the application of nuisance authorities empower them to make regulations as to lodging-houses, but the section does not apply to common lodging-houses.

The Public Health Act, 1848, is now repealed, and so are the two Common Lodging Houses Acts, except so far as relates to the Metropolitan Police District, but the fourteen clauses referring to common lodging-houses in the Public Health Act, 1875, scarcely do more than re-enact the old provisions. However, under this Act the local authority's officer has freer access, and every keeper is required to mark his premises in some conspicuous place outside as a registered common lodging-house.

And now let us see how these arrangements for registration and regulation work. The regulations adopted in most districts have been probably in accordance with those issued under the authority of the Secretary of State. Even since the repeal of the Common Lodging Houses Acts, the old regulations so long regarded as models have still held their ground. These, however, as anyone who has

* The words used are—"for the well-ordering of such houses, and for the separation of the sexes therein."

had experience in the matter will admit, are insufficient to accomplish the object sought. For example, take the following extract from Regulation 8—"The blankets, rugs, or covers used in such lodging-house shall be thoroughly cleansed at least four times every year, that is to say, at least once some time during the first week of each of the several months of March, June, September, and December." Is this sufficient for cleanliness? Or take Regulation 11, in which the existence of lodging-houses without yards is clearly recognized, and two or more houses uniting to provide a single "convenience" is sanctioned. I would draw attention also to Regulation 12, requiring that—"The sink in the yard shall be so placed as to take all waste water through the drain from the closets," which is certainly not an arrangement to be commended. There is nothing to be gained by criticizing further these regulations, more especially as they now have no official authority; yet I believe that the regulations this day hung up in most common lodging-houses are little, if at all, in advance of the models.

And what is the result? I will tell you.

The poor traveller arrives in a town, and goes in quest of lodgings. He is a decent man, and particular that the house he selects shall be a registered one, as he thinks this gives him some guarantee that his quarters shall be clean, airy, quiet, and well-ordered. He pays his fourpence, and is admitted by the "deputy," who represents the only authority in the building, the actual proprietor being a publican, an eating-house keeper, or marine-store dealer—that is non-resident. The room that he is shown into (the only one in the house not a bedroom) is already more than sufficiently full with men, women, and children. One lodger is frying tripe, another toasting herrings, two or three are drinking and smoking or singing, while in a corner, it may be, a woman is busy washing clothes. Unless the new arrival is willing to join in the drinking and singing, and pay for a share of the beer, a seat is only found for him grudgingly. In any case, he can scarce stay long in this room without getting a headache; so he leaves the convivial party, and goes to bed. But up with him, too, comes the steam from the washing-tub, and the tobacco-smoke, and the smell of many savoury suppers. The wooden bedstead is old and infirm, and the tick upon it is filled with flocks hard with much lying on, and the covering is a folded blanket. Bedstead, bed, and bedclothes are all dirty, and with a sigh the poor traveller prepares for his night's experience. Taking a look round, he notices the entire furniture of the room consists of three bedsteads, an iron bucket, and a line stretched across from wall to wall, on which he hangs such of his clothes as he divests himself of. The fustiness of his surroundings, the noise and fumes from downstairs, combine to keep the poor traveller awake till the revellers join him. Two turn in to each of the other beds, and his bedfellow, not steady enough, it may be, to attempt undressing, lies down, boots and all. What is the poor traveller to do? He is too hot in summer, too cold in winter. He wants a draught of water—he cannot have it. He wants to bathe his face—he cannot

do it. In superlative discomfort he keeps his vigil, perhaps till early dawn, when

> "Wearied out, he sinks to sleep,
> To sleep, but not to rest."

This is no mere fancy picture. I have never played the part of an amateur common lodger, but I have visited many registered houses in the daytime, in the evening, and in the early morning hours, and I describe to you what I have seen. I ask you now, as I have often asked myself, is the poor traveller fairly dealt with? We pretend to take a special interest in him, and see that he is provided with a clean bed, sufficient breathing space, and a tidy room in a well-ordered house, and we stamp the room and house with our official stamp to show that we are really in earnest. He respects the Sanitary Authority, and learns too late that it sanctions dens of dirt and overcrowding and impure air.

What has been and is required as regards common lodging-houses is the repression of overcrowding, and securing cleanliness, sufficient ventilation, and decency. To obtain this, two things are necessary—(1) a well-considered set of regulations; and (2) due provision for systematic inspection. The second is at least of equal importance with the first. A well-ordered common lodging-house is then perfectly practicable? Undoubtedly in large urban centres it is. Nay, more—in Glasgow, Liverpool, Manchester, Birmingham, Bristol, &c., it is an accomplished fact. The difficulty I am speaking of does not arise in large cities and boroughs where the accommodation required is on a large scale and readily afforded by private enterprise, and where inspection is systematic and in the hands of properly trained inspectors. It is not of the great populous centres the poor traveller has reason to complain, but of urban districts where precisely the opposite conditions obtain, where it will pay no one to open a big house as common lodgings, because the sum of the beds there is a demand for is so small, where there is no systematic inspection, no night inspector, no security as regards the separation of the sexes. The local authority I serve, I regret to say, is much in this position. We have but eight common lodging-houses on our register, all situated in the same neighbourhood (five being in the same street), and all being poor, squalid little dwellings. The sum of the beds registered is forty-eight.

What is to be done by towns thus circumstanced? It is a perfectly hopeless task attempting to reform the existing common lodging-houses; the one course which promises satisfactory results is for the authority itself to provide the requisite accommodation. This, however, the Sanitary Authority has no power to do. It may provide public baths, washhouses, open bathing-places, infectious diseases hospitals, disinfecting houses, patients' conveyances, vans for the transfer of clothes, and mortuaries. Why may not urban authorities provide common lodging-houses? It is surely of as great importance to a town that its poor shall be wholesomely lodged as that they shall have facilities for washing themselves and their clothes. The Public Health Act should surely have given us

this power, and when the opportunity occurs, steps should be taken for securing it. Even if reform of the wretched hovels called common lodging-houses, as they exist in most small towns, were possible, it could not be accomplished at a less cost than the provision of lodgings which should be absolutely perfect. In ordinary cases I would not advocate the erection of a special building, but the hiring of a pair of suitable houses—one for male and the other for female lodgers. A man and wife could be put in as caretakers, and these being the servants of the Sanitary Authority would of course act as night inspectors. Each house should have a sitting-room, kitchen, and wash-house, and the bedrooms should be furnished with small iron bedsteads. The ventilation should be automatic, and independent of the opening and shutting of windows.

I shall not go further into details, but I think you will see that the plan is quite feasible if only the Sanitary Authority had the necessary powers. Such an establishment as I propose could never be overcrowded, there would be no double beds in it, and it would be at all times cleanly, tidy, airy, decent, and well-ordered. As for the keepers of the old lodgings, they would soon find their occupation gone, and in course of time the houses would be put to some other uses.

I trust that what I have said may have succeeded in awakening sympathy for the poor traveller, and drawing attention to some of the circumstances of his surroundings. Each individual has a personal interest in giving this matter his earnest consideration, for the baneful effects of neglecting common lodging-houses are not restricted to their occupants.

F. VACHER, *Medical Officer of Health for Birkenhead.*

The Influence of Efficient Sanitation in the Prevention of the Himalayan Plague.

The plague of Egypt finds a congenial soil in the Himalayahs; and India has been described as the home of cholera.* On a future occasion I hope to give a detailed description of the former disease as it occurs in the Himalayan valleys; the present account pretends to nothing beyond a mere sketch. The Himalayan plague, known locally as *Mahamurree*,† was first noticed by a Europan traveller in 1823. But it attracted no special attention till 1850-51, when the inhabitants, inspired by terror of the enemy, whose visitations were periodically becoming more frequent and virulent, began to flee the country in such large numbers that the Indian Government unable, in consequence of this wholesale exodus, to collect the

* Macpherson's "Cholera in its Home."
† From *maha*, great, and *murree*, disease.

usual revenues, instituted an inquiry. The administrative medical officer of the district, and a junior surgeon on duty in the Hills, from which he was temporarily detached, were deputed to make investigations. Both agreed that the disease was a low fever of the most active type, aggravated and fostered, though, doubtless, not caused, by the filthy habits of the people and their unwholesome surroundings. It fell to my lot to be subsequently associated with the surgeon above referred to—Dr. Francis Pearson—in a special organized inquiry into the whole subject—an inquiry which extended over two years. We both unhesitatingly came to the conclusion, after observation of several cases, that *Mahamurree* was identical with the veritable plague.* There was the low prostrating fever running a remarkably rapid course, accompanied *occasionally* by hæmorrhages, vibices, and petechiæ, *always* (where there was time for their development) by buboes in the groin, or other glandular swellings; and the disease was highly contagious. The fifth, in all but the speedily fatal cases, was the critical day. If the eighth was reached, the patient, as a rule, was safe .Suppuration of the inflamed glands was a favourable sign. To promote it the natives would thrust in a red-hot packing needle. Profuse perspiration was also a good omen. These happy events would occur, if at all, between the above-mentioned days.

A remarkable feature in connection with an outbreak of *Mahamurree* was the death, in the first instance, of the rats.† A rat would emerge from his hole, and walk along the floor of the apartment as if intoxicated; then, performing a gyration or two, he would bring up some blood, and die. A *post mortem* examination revealed a perfectly healthy state of all the organs *except in the lungs*, through which were distributed small black carbonaceous looking patches—little islands of hœmorrhage, in fact. As in the Himalayan villages the rats were invariably first attacked, their fate might have served as a warning.‡ If the human inhabitants had accepted it, and gone for a time into the adjoining woods, all might have been well. But, instead, they would linger on until one of themselves would become a victim. Then, they would flee in all directions; the ties of kindred being in many cases quite lost sight of. Husband and wife would separate from each other; parents would leave their children; and the saying of a man shunning his neighbour "as if he had the plague," was here illustrated in all its grim reality.

Then, the bears would come and hold high revels in the deserted villages: and granaries of grain, stored for the next winter, would be consumed in a few hours.

Remedial measures were of little or no avail. In some cases

* This is Pettenkofer's opinion.

† This feature has also been observed in Syria, &c. The fact seems to point to the special virulence of the poison.

‡ In some plague stricken villages at the foot of the Himalayahs the rats were not the first victims.

death would supervene so rapidly that there was no time for medicine to act. In those that ran their course of five days and upwards, there was no arrest nor diminution under treatment of the symptoms. The vast amount of general internal congestion that was revealed at the single *post mortem* examination that we had an opportunity of making, indicated the necessity for remedies to relieve this condition, and to equalize the circulation. Calomel, however—the best of these remedies—was a hazardous drug to prescribe in so prostrating a disease; and the results obtained from large doses of quinine and other febrifuges were not altogether satisfactory. Two or three individuals did indeed recover, but it is questionable if we cured them. Even in the cases most favourable for treatment, they were not seen early in the attack. We furnished the villagers, through their head men, with supplies of medicines, and pointed out how certain indigenous plants might, in the absence of these medicines, be utilized; but it was evident that the best measure of all was *prevention*. Living, as each family did, in a small, almost hermetically sealed, overcrowded hut of two compartments, the lower being occupied by the cattle and the upper by the family—I once counted thirteen in one—all available spaces being taken up by the baskets of grain, and the solitary hole in the wall, which served the purpose of both chimney and window, being carefully stuffed with straw; and the surroundings being composed of ancestral heaps of manure, with vegetation flourishing and *decaying* upon them; and hemp and other growths, rising to a height of from 8 ft. to 12 ft., and impeding the circulation of air about the little village; these were conditions calling loudly for the Sanitary reformer.

Upon the recommendation of the medical authorities, Sanitary measures were under the superintendence of the magistrate—(it was found advisable eventually to invest Dr. Pearson, who, at the close of the inquiry, remained as a special *Mahamurree* officer, and superintendent of vaccination, with magisterial powers)—actively carried out; and, in consequence, the plague in those hills, which used to show itself biennially and triennially or even annually, has been practically extinct for the past twenty-five years. During this period the disease has once or twice threatened to become epidemic; but it was discovered that a temporary relaxation of the Sanitary regulations had led to this result. It is now, however, generally admitted, even by those who are lukewarm in the cause of sanitation, or see no good in it, that here, at any rate, it has been of decided benefit. Such persons have admitted that it is altogether a "neat case."

It is satisfactory to know that the risk of infection from *Mahamurree* is (such, at least, is the well-founded belief) limited, as a rule, to the villagers themselves. The disease is epidemic only where it is *endemic*. No pilgrims—sometimes a numerous body—('tis true that they would naturally give infected villages a wide berth) have ever, any more than ordinary travellers, been attacked by it as they journeyed from their homes in the plains to the

mountain shrines of Gungotri,* Jumnotri, Budrenath, &c. Nor did we ourselves nor any of our native followers suffer.

Mahamurree appears in a plague latitude; and, though probably of telluric origin, finds its home in a combination of suitable surroundings, such as would hardly be met with in any other latitude. The higher temperature of the *plains* of India, combined with the personal cleanliness of the people (the hill native of Gurhwal, where *Mahamurree* is especially rife, rarely washes, and his *woollen* clothing is worn till it drops off!) are opposed to the *descent* of the disease in that direction. Simultaneously, with outbreaks in the hills, the disease has indeed appeared in two adjoining villages in the districts immediately below, but the cause has in each case been traced to contagion. In these villages the *rats died after the people were attacked*.

The plague, due to importation, also appeared some fifty years ago on the western coast of India—under the name of the *Pali*; but its area was limited. These instances of plague appearing in the plains of India show the *possibility* of its extension into them; a fact which, in addition to other obvious reasons, quite justifies the Indian Government in maintaining a separate medical officer to carry out Sanitary legislation in the Himalayahs.

C. R. Francis, *late Surgeon-General Indian Army.*

The Unhealthiness of Public Institutions.

The unhealthiness of public institutions is becoming more and more an admitted fact. Hospitals, asylums, schools—to say nothing of convents, refuges, and homes under private management—have of late all shown signs of unhealthiness, which should not exist in such institutions, notwithstanding that people say that sickness exists everywhere, and must therefore be necessarily found in all public institutions! Is this so? We doubt this postulate, and for the following reason:—Since the prisons of this country have come under the control of Government, they have gradually been made probably the healthiest residences in the United Kingdom. Dr. Gover, the Medical Inspector of Prisons, in his "Notes," attached to the Second Report of the Prison Commissioners, gives incontrovertible evidence of the truth of this fact. He proves that in all the prisons of England and Wales, during one entire year, only one case of small-pox, and not a single case of scarlet or typhus or gaol fever occurred. What a contrast to the old days when gaol fever was so alarmingly fatal to prisoners, judges, juries,

* Sacred Hindoo shrines in the snowy regions, bordering on the Thibetan plateau.

and indeed to all who had business at the criminal courts, that history too often marks its ravages in certain towns by recording there a black assize. Again, only fourteen cases of typhoid fever are reported by Dr. Gover, five of which occurred in one prison, in an infected district. In the majority of the prisons there was not a single case of typhoid fever throughout the year. In the fourteen cases reported, the origin of the disease was invariably traced to Sanitary defects, which were proved to have been in existence before the Government had control of these establishments. It is, therefore, reasonable to hope, that during the present year typhoid fever will also be banished from all the prisons. Why should such a desirable guarantee of health be confined to the occupants of prisons? Before giving the reasons for this startling anomaly, it may be well to state that only typical and published proofs of the unhealthiness of the great majority of public institutions and its causes will be given in this paper. A departure from this rule would necessitate an abuse of confidence which would be neither politic nor just. Again, no detailed remedy will be suggested, because the necessities of each institution will require separate consideration, and, probably, distinct treatment.

Having said so much by way of preface, to obviate misunderstanding, I proceed to ask why, in the face of the facts stated by Dr. Gover, do the authorities of other public institutions look upon the presence of a certain number of cases of zymotic disease as unavoidable? They must believe this to be a sound position, or it would not be possible to record such cases as the following:—The Manchester Infirmary, one of the oldest, largest, and most important of provincial hospitals, was, less than three years ago, declared, by Mr. Netten Radcliffe, to be "unhealthy from cellar to garret."* Its Sanitary condition is bad. Yet the authorities of this institution had been warned, over and over again, during a series of years, by outbreaks of pyæmia, erysipelas, and other traumatic affections, that something must be wrong. But, some one may say, why should such outbreaks be taken as showing the insanitary condition of a building? I answer, sewer gas has been proved to be a prolific cause of erysipelas, and it is now shown to cause much pyæmia in hospitals. I will not now give evidence of the truth of the former statement. I have never heard it contradicted. But of sewer gas as a cause of pyæmia, I would say that the following instance seems to prove the case beyond dispute. Pyæmia occurred in the chief surgical ward of a large hospital three years ago. This ward was built upon the pavilion principle, and was quite separate from all the other hospital buildings. Some thirty patients were affected in a few weeks, and so violent was the outbreak, that the surgeons declined to operate. At that time the sewers were unventilated, and all soil pipes were in direct communication with the sewer. No sooner, however, were these defects remedied, than pyæmia entirely disappeared. No other cases of pyæmia occurred for six months, when, all of a sudden, the disease

* *Sanitary Record*, Vol. x. p. 371.

again appeared in a virulent form. As it continued, the ventilating shafts from the soil pipes were examined carefully, and it was discovered that they were stopped up. Some workmen had been engaged on the roof, and as they objected to the smell from the ventilators, they had closed them with pieces of rag. This is a proof of the necessity of a regular inspection of all ventilating shafts, open soil pipes, &c., &c. Of course, the ventilators were at once put into working order. Since then, during two whole years, the disease has almost disappeared from the hospital. In this connection it is fair to give expression to the conviction, which is founded upon observations during many years' residence in a hospital, that had not Mr. Lister introduced the antiseptic system of dressings, several of the older hospitals must have been closed long ago.

Now, it has been shown that one of the oldest and most important of provincial infirmaries proved on investigation to be unhealthy from cellar to garret. It has further been shown that sewer-gas is a prolific cause of pyæmia and erysipelas. It remains to connect cause and effect. On examination and inquiry it was found that no one connected with the management of the Manchester Infirmary could give Mr. Radcliffe, the Government Inspector, any reliable information as to the drainage arrangements of the building. In fact, excavations had to be made here and there to ascertain the exact condition of drainage affairs. Alarming and astonishing as this statement may appear, its effect will be increased a hundredfold by the declaration, that investigation has brought to light, that not ten, and possibly not five per cent. of all the hospitals throughout Great Britain and Ireland possess any *reliable* plan of their drainage arrangements. Even some of the most important hospitals in the kingdom have no such plans, and it would be easy to give instance after instance of the culpable ignorance which prevails on this important subject. What then is the probable condition of the drains of an institution built, it may be, fifty years ago? Remembering the action of sewer-gas upon hospital patients, and considering the only answer that can be given to this question, is it much use fighting about the comparative healthiness of different medical charities until so crying an evil is redressed? For my own part, I have no doubt that hospitals where the antiseptic system is enforced can be made as healthy as the prisons to which reference has already been made. Hospitals belong to a class of institutions which ought to be specially provided with adequate Sanitary arrangements. The unhealthiness of such institutions is a serious matter, because it not only places in jeopardy the reputation of the medical staff, but the lives of many thousands of the people. It cannot, therefore, be doubted that if the attention of the committees of these institutions is once aroused to the importance of having an adequate system of drainage, a remedy will speedily be forthcoming.

Turning now to the health arrangements of the large lunatic asylums of this country, a fair insight may be gained into their condition by recalling the evidence recently given at Frome before the

Somersetshire coroner.* From this evidence it appears that from December, 1878, to May, 1879, thirty-two cases of spontaneous erysipelas occurred among the inmates of the County Lunatic Asylum. Of these, twenty-three cases broke out in the female infirmary ward, and nine on the male side. Of the whole number nine died. At the time of this outbreak complaints of ill-health were made by very many other patients. Nausea, headache, sore throat, and general *malaise* were long prevalent, and these symptoms were followed by an epidemic of diarrhœa. Bad smells were noticed in all parts of the building, and it soon became evident that sewer-gas was almost everywhere present throughout the asylum. The medical superintendent, Dr. Medlicott, had his suspicions aroused, and a thorough overhauling of the drainage arrangements took place. These investigations disclosed the following instructive facts. None of the soil-pipes were ventilated. Most of them were of lead, and several were rat-eaten, and riddled with holes. On taking out the pan and syphon of the infirmary water-closet, a hole in the soil-pipe, 3 in. by $1\frac{1}{2}$ in., was discovered. This soil-pipe communicated directly with the main sewer. The main drain outside the infirmary ward, where two-thirds of the erysipelas cases occurred, had been choked more than once during the year, on one occasion to the extent of from three to four yards. In consequence of an insufficient fall the main drain had been stopped several times. Thus, it is clear that for months, and probably in an increasing degree for years, the inmates of this County Lunatic Asylum had been subjected to the influence of gases, generated by fermenting sewage, which were constantly brought to the interior of all parts of the institution by the unventilated soil-pipes, from which poisonous vapours were admitted within the buildings, through the rat-holes above described. No wonder the jury declared that the erysipelas was proved to be due to an escape of sewer-gas, owing to the insecure and insanitary drainage arrangements. How many lunatic asylums in different parts of the country are liable to a similar outbreak of erysipelas for like reasons?

Uppingham Grammar School is a typical instance of the dangers arising from defective drainage at the public schools. The experience at this school was sharp and decisive, and it has tended to arouse the authorities of several other large schools to active exertion. But who can say how many masters and governors of semi-public schools and colleges are ignorant of the present state of their drainage systems? If we include private schools, the Sanitary condition of the buildings used as school-houses must often be terribly deficient.

I have not the space to give my experience of the hygienic (?) surroundings of convents, refuges, homes, and other like charities. I shall, therefore, content myself with the observation that the conclusions I am forced to draw from investigations I have been making in Dublin during the past few weeks, strengthen the conviction I

* *Sanitary Record*, Vol. x., p. 357.

had already formed on the subject. This conviction is, that if the unfortunate inmates of these religious and charitable institutions often suffer cruel hardships at the hands of those who have charge of their management, the Sanitary arrangements, for the most part, of such buildings, must render residence within their walls highly dangerous to health.

Finally, I do not think it is too strong a statement to say that the probabilities are decidedly against there being one in ten of such institutions, that would stand an impartial investigation into its drainage arrangements without producing as startling revelations, as those made at Manchester and Frome.

The facts I have here given—facts selected from a number of instances I have collected during the past few years—abundantly bear out the assertions of Dr. Buchanan. Speaking of improper connections between sewers and buildings, he declares that in this way the air of sewers is laid on to the houses. The larger the house, the greater is the danger, as, unless the drainage and plumbers' work have been executed in the most perfect manner, every bath, every lavatory, every sink, and every waste-pipe is an additional danger. How fully the experience of the Somerset County Asylum bears out the truth of Dr. Buchanan's words! What, then, is to be done? Is it longer to be tolerated that the lives of many innocent persons, who, from being placed in these public institutions, are powerless to help themselves, shall be annually sacrificed because no adequate drainage arrangements exist in the majority of such buildings? The answer to such a question cannot be uncertain. The moral is plain to read, but difficult yet to apply: First, let every responsible person who is connected with any public institution take the facts here adduced to heart. Let every committee, or council, or board of governors at the next meeting, ask for a plan of the drainage arrangements of the hospital, or asylum, or school in their charge. If this is forthcoming, let there be no loss of time *in testing its accuracy*, and, under any circumstances, let them procure a report from a competent expert of the exact Sanitary condition of all the buildings in their charge. In this way the truth can alone be ascertained. If the authorities longer neglect so plain a duty, it will not be unreasonable for a jury to bring in a verdict of manslaughter should any deaths be produced in future by sewer-gas, from causes similar to those exposed at the County Asylum at Frome. With the report of Dr. Gover before them, the managers of all public institutions ought to take courage, because such a report shows that preventive medicine is a great fact. Experience has now proved that sometimes science can point to such unanswerable evidence with the proud assertion, prevention is better than cure. It is a scandal that the insanitary condition of so many private houses is the origin of so much avoidable disease. It is a disgrace that any public institution should be without a reliable plan of its drainage, or a perfect system of hygiene. How much longer is it to be possible to declare that if a man is really anxious to guarantee to himself six months' perfect immunity from preventable disease, he must get committed to one of Her Majesty's

prisons? And why? Because private houses and public institutions are not free from preventable impurities, whilst lodgings, and even hospitals, are too often, compared with prisons, highly dangerous abodes for any one who has a tendency to zymotic disease. In Ireland most of the public institutions are in part supported by Government grants. In England and Scotland this is seldom the case. Still, Government grant, or no Government grant, adequate Sanitary precautions ought to be taken at all public institutions to protect the lives of the inmates. No permanent reform is likely to be enforced without a thorough, an independent, and a periodical inspection of all the structural and drainage arrangements of these buildings. It would, therefore, be a great public gain if a Special Sanitary Inspector could be appointed, whose whole time should be devoted to the inspection of the Sanitary arrangements of public institutions, good, bad, and indifferent. Will the Congress support this view by resolution? Such a recommendation to the Local Government Board would not be invidious; because the managers of these institutions are becoming more and more alive to the Sanitary difficulties which have to be overcome. Hence, the institutions would willingly welcome the help, and follow the guidance of such an expert. The managers of these institutions pay handsomely for a periodical inspection of the boilers and machinery in these buildings, because they appreciate its value. The Sanitary Inspector would be more welcome still, because he would not only reduce expenditure, but he would increase the health of all the inmates. At any rate, the compulsory registration of the plans of all public or semi-public buildings is a much needed reform.

HENRY C. BURDETT.

Nurses: How to Make them, How to Use them, How to Pay them.

THE propriety of reading a paper on Nursing at a Sanitary Congress will be pointed out more particularly at the close of this paper. At this stage I will only say that the President of this Congress, on hearing accidently from me what had been done in Derby during the last fourteen years in connection with our "Nursing and Sanitary Association," said, "You should bring the question forward at Croydon; Dr. Carpenter's section on Sanitary Science and Preventive Medicine will give you a hearing." As Miss Nightingale well says, probationers must be sober, honest, truthful, trustworthy, punctual, quiet and orderly, cleanly and neat, patient, cheerful, and kindly, and to these qualifications let me add that they should be Christians with a single eye.

And where, it will be asked, shall we look for such? I answer,

Expect to find them everywhere. There are more women of this kind than people commonly suppose. They are not met with easily, perhaps, but that is very much because such people are commonly retiring and unobtrusive. They have something in them of the nature of the sensitive-plant, but there are such people in the world, and the way to get them is to let them know that they are wanted. Let the public see to it that openings are made for them. In other words, let the demand be for this kind of women and the supply will, in obedience to the rule, be forthcoming. They will come quietly, dropping in one by one, and the kind of women that you will get in any one locality will depend very much upon the atmosphere—that is, the nursing atmosphere of the neighbourhood—the training that you give them—the way you use them—pay them—treat them after they are trained, and, last not least, the kind of house you provide for them. At present at least Homes are necessary, and the house will depend upon the lady who has charge of it.

I will not further anticipate what is to follow, but proceed at once to consider more definitely how to make these women into nurses. There are exceptions to every rule, but, in all ordinary cases, nurses must be made in public hospitals. To this special use of hospitals the attention of the public requires to be directed; the public should take more care than it has done that every hospital in the kingdom is used more or less as a school for nurses. Certain large hospitals in the metropolis, and a few in the provinces, have long been recognized as useful and necessary for the education of medical men; and if the students are under proper surveillance the hospitals are improved by being turned to this account. In like manner, only to a larger extent (for there should to this be no exception), hospitals should be schools for nurses; and if the nurses are placed under proper direction, the hospitals will be improved thereby. The question as to the regulations under which these women should be admitted must be dealt with cautiously. So far, however, as I have observed, it is not necessary for the hospital to do more than to provide proper accommodation for these women, and to take care that the nursing is under the direction of a qualified lady. This lady should have unfettered liberty in the choice of her staff and of the pupils (or probationers, as they are called), for upon her must rest the main responsibility of the service. I think also that the lady superintendent should invariably be responsible, not to any outside authority, but to the general board of management. Let these simple points in all their fulness be admitted—that a hospital is not doing its duty properly if it is not training nurses; that in order to train nurses there must be some one person responsible for the selection of such women as I have named, and duly qualified to give them instruction; and thirdly, that this person should be, like every member of the staff, under the control of the general board of management. Then, for all practical purposes the question is answered—How to make nurses.

I pass on to the second point, How to use them? This second question may be answered by one word—use them *well*. Don't pet

them, but take good care of them; use them as servants, but remember that their service is special, and use them for that and not for other kinds of service. Do not, for instance, in a hospital let the nurses scrub the floors or clean the grates. I know that in some institutions this menial service is required of the probationers as part of their training! I hold it to be a mistake to set even probationers to scrub floors. Let me not be misunderstood. I would not have a nurse refuse, under exceptional circumstances, either to wash a floor or to clean a grate, but the circumstances must be very exceptional. Again, use them well by providing that they shall have good food, and proper time for rest and relaxation. It is false economy—to take no higher view of the question—to overwork a nurse. I plead not for luxury, but I plead for that which experience proves cannot safely be left to chance either in hospitals or in private families. Use your nurses well, treat them with confidence, take care of their health, be careful that they have a sufficient amount of sleep and fresh air, beware above all things of giving them stimulants "to keep up their strength," and do not expect from them that which is unreasonable. It will scarcely be believed, but I have known a person think that a nurse, because trained, would be able to stay on duty night and day. When she was remonstrated with, this ignoramus replied, "I thought that she was a trained nurse."!!

But even where employers require nothing so unreasonable, it is well to remember that nurses themselves—some of the best nurses—will overtax their strength unless we act not only as their employers but as their protectors. I shall have something more to say on the employment of nurses afterwards, when speaking of nursing associations, but I pass on now to the third point: How to pay nurses?

This question, like the last, may be answered by one word, and by the same word—pay them *well*. By this I do not mean pay them extravagantly, at the same time I do mean pay them properly, honestly, and if you will take my advice you will insist upon it that they are paid. You may rely upon it, that there are few exceptions to the rule "that which costs nothing is worth nothing," and before nursing is admitted to be one of these exceptions, I venture to suggest the inquiry, whether those who nurse "for nothing" are not, sooner or later, paid in some other way. At any rate, let me say, that the attempt to divide nursing into paid and unpaid, and to speak of unpaid nursing as if it were necessarily superior to that which is paid for, to throw a reproach upon paid service by using such terms as "mercenary," "hireling," &c., is a great mistake, an injustice, and an expensive fallacy. My advice, then, is pay them. Insist upon paying them properly the full money value of their services; let there be no debts on the one hand; on the other, let there be no indebtedness, except that debt of gratitude which money may acknowledge, but can never pay. I am quite ready to admit that if you treat nurses with confidence and consideration, it will greatly enhance the value of any money payment; but as to the money itself, let it be a plain, straightforward piece of

business. Thus you will see that these questions may be answered in a very plain, common-sense way; and this is precisely the way in which all questions about nursing should be dealt with.

It will serve to test what I have already laid down and to extend your interest in the subject if I make a few more remarks on the employment of nurses. There are three tolerably distinct fields of work in which nurses may be employed in hospitals, in private families, and amongst the poor in their own houses. I do not propose to say anything more on the first two—nursing in hospitals and nursing in private families, but on the employment of "district" nurses amongst the poor a few practical suggestions may be acceptable. And first, just as nurses in a hospital need to be under the direction of a resident lady-superintendent, so district nurses among the poor must be superintended; and further, the superintendence must be by some one who is their superior in position and in knowledge. The lady-superintendent should herself have had training. If the nurse knows more about nursing than her superintendent, you can well imagine that the superintendence will be more a name than a reality. Of course, one person, if specially set apart for that duty, can superintend many nurses, and in a large town this is by far the best plan. She must, as in the case of hospital nursing, choose her own staff, and the same person can very conveniently and effectively take charge of the other nurses who are to be employed in private families. Then the Home for these nurses should be made the residence, and a comfortable one, for the lady-superintendent.

Again, the institution will soon become a valuable centre of all nursing business, a store-house for sick-room appliances, couches, pillows, bath chairs, &c. &c., an invalid kitchen, and the place for getting help of various kinds for convalescents, sending them to the sea, giving them extra food and clothing, encouraging them as much as possible to help themselves. As to the loan of sick-room appliances and the supply of comforts of other kinds from the kitchen, the nurse should simply distribute what the lady-superintendent directs; least of all should the nurse be allowed to give stimulants at her own discretion; indeed, the wants of the sick poor are so many, and of these so many rank in importance before stimulants, that I should myself be quite willing to have stimulants struck off the list altogether. Proper food, bed-rests, couches, air-pillows, clothing and such things will more than consume the supply that the public can be expected to furnish. Stimulants too often mean want of fresh air and want of good nursing. As a general rule, a good nurse and stimulants are at the antipodes, when the one comes in the other goes out, and *vice versâ*. It is in this department of district nursing that the Sanitary aspect of the question becomes so conspicuous. A district nurse going from house to house among the sick poor is a most valuable health-officer, and this leads me to remark that when you come to organize a nursing association you will find it practically of great service to regard it as much as possible as a Sanitary question, rather than for instance an ecclesiastical one. It should be a nursing and Sanitary association.

At Derby, from the first, the object of our association was stated to be "to provide thoroughly educated nurses for the sick both among the poor and in private families, and to organize means which shall tend to the prevention and more or less directly to the removal of disease." This basis has proved itself after fourteen years' trial to be a sound one. It covers all the ground. It enables you to take up as occasion may serve any Sanitary question that arises (without starting a new society). There are many such questions in connection with nursing which cannot be separated from it, for instance, the providing change of air for convalescents and giving of them extra food, and thus materially contributing to the stability of the cure,—nay, more, the feeding of weakly ones, children and old people who want food not physic for many of their ailments. The establishment of cottage-hospitals, and to mention only one more—the latest development of our work in Derby—the delivery of health-lectures.

You have no doubt heard in Croydon of "Ambulance" classes—a term borrowed from military service, but specially adapted to the wants of civilians by the Sovereign and Military Order of St John of Jerusalem. So far as I am aware, in every place except in Derby, these classes have been an importation from that quarter. But in Derby from the commencement we have declined all and every outside authority. We lose something thereby in prestige and patronage, but we gain in freedom and in power of adaptation to circumstances. We require, as I have said, our nurses to have a single eye, our organization in like manner has been "single." In this way you escape both Scylla and Charybdis.

The Apostolic maxim, "Study to be quiet, and to do your own business," will not fail you in nursing, least of all, when it comes into contact with other business, even business more important than itself, I mean of course, when it comes into contact with religion. The so-called religious difficulty may always be satisfactorily and thoroughly disposed of in this way. There need, in fact, be no difficulty; any semblance of one "*solvitur ambulando.*" Go straight forward: bring the question at once to this simple issue, Is it nursing? Is it good for nursing? If it is, adopt it. If not, reject it, and do this at all costs. If it is a doubtful point, leave it open. Religion that will not bear this simple but, let me add, searching test, has something wrong in it; at any rate it will not serve you in nursing the sick. Thus I have endeavoured to answer the three questions proposed about nurses, how to make them, how to use them, how to pay them. In doing so, I have shown that the question is capable of very considerable enlargement. This extension if not forced, but allowed to develop itself naturally, falls strictly within the province of the business of this Congress, and of that particular department to which this section is devoted, "Sanitary Science and Preventive Medicine."

W. Ogle, F.R.C.P., M.D.

Some Remarks on Hereditary Influence.

What will be the future of man (considering him merely in reference to his animal nature)? Whether his body and mind will degenerate, or whether both will rise superior to what they now are, is a question of such intense interest that one wonders it has not more often engaged the attention of philosophers than it has.

Treatises on Education (meaning by education the improvement of the existing generation) are legion; whereas treatises on Heredity are very few. The word has hardly yet been realized in our language, and, perhaps, there are many here present who have never heard it at all.

Now, the definition of Heredity is *the sum of those qualities of body and mind which, being born with us, are transmitted to our children* in contra-distinction to those qualities which are acquired afterwards by self-improvement or education. And as the subject is one about which there is a great deal of vagueness and indistinctness, even amongst the best writers, I will ask your indulgence, while I endeavour, before proceeding further with this paper, to make my meaning clearer by giving some homely instances of it.

Let us suppose a person to be born with a bad temper, but to exercise a self-control and be actuated by a sense of duty that enables him or her to reverse it—then, according to my view, the *unchanged*, not the changed, temper will pass to their children. Or, again, suppose a man to have a bad memory, but to improve it by study and attention to business, I contend that his *unimproved*, not his improved, memory will be transmitted to his offspring.

This theory of Heredity is controverted by many—especially by the advocates of education, who assume that instruction conveyed to children will pass on to their children again, not in the way of precept and example merely, but *naturally*, through the blood. And a very similar doctrine is used by writers on pauperism, and on temperance, and above all by men who adopt the false theory (false, at least, in my opinion) of evolution.

I will not, however, delay you by entering into controversy with them, because, for the purpose of my paper, I assume it to be *an axiom*, that *acquired* habits of individuals, whether human beings or animals, are *not hereditary*. And my object will be to point out certain circumstances which, viewed from this standpoint, seem likely to affect our posterity.

I. The first circumstance I shall name is *the large increase of wealth accruing from trades and manufactures* and the *comparatively small increase arising from agriculture.* The consequence of which state of things is a perpetual flow of population from the rural districts to the great commercial centres of cities and towns.

Now this migration operates in a peculiar manner, inasmuch as by far the larger portion of those who so migrate are women—(a fact, of the truth of which anyone may satisfy himself by turning to the census of the last two decades). And it requires but little

consideration to prove that the women so migrating are among the most attractive—at all events, the ablest, and such as have the greatest capability for work.

If a girl of humble origin is superior either in mental advantages or personal attractions to those who surround her in her native village, the probability is that she aspires to some higher position than that of a labouring man's wife. She becomes an assistant in a shop, or, if of more intellectual tendencies, possibly a schoolmistress. Her time is taken up and her attention engrossed with her duties, and she becomes comparatively old ere she becomes a married woman. Country villages are thus deprived of the best looking, the most healthy and the most efficient of their female population; while the agricultural labourers are of necessity obliged to take less gifted wives, and consequently have less gifted offspring.

II. A similar cause of deterioration and, perhaps, a greater one, inasmuch as it affects a still larger class, is *the celibacy arising from domestic service.*

Maidservants are taken chiefly from rural districts, and selected by their mistresses for efficiency in work, and, in a great degree, because of personal appearance. I do not mean that this last quality is ostensibly put forward as a requirement for service, but it is so practically; for no mistress would receive a *very* plain girl into her household, and certainly none would receive a deformed one. Thus women who might have made the most eligible mothers are taken away in order to be servants; and few of them return to their villages after having become used to a way of living which disinclines them from encountering again the hardships of cottage life. For the most part they remain in service, and consequently single, until an age which renders a family doubtful; while others gain the confidence of their employers, and remain in the servant life till the end of their days.

The evil arising from this is that the agricultural labourer, being restricted in his choice of a partner by the flower of his female surroundings being taken away, is obliged to fall back on the less good residuum. And, as in the case I described before, the race is rendered less efficient in mind and body, and in every sense less gifted by nature.

It would be difficult to suggest any remedy for these two causes of deterioration; and all the more difficult, because that the motives from which they originate are in themselves laudable ones. It is laudable, no doubt, in a young woman to seek to raise herself from the low and too often immoral condition of an agricultural labourer's daughter to the comparatively respectable condition of a domestic servant, or the still higher status of a schoolmistress. But it is this very rise which prevents her marrying. Regret the fact as one may—and sorry as one is to announce it—yet it is a fact, and whatever raises young women in respectability renders them more unlikely to marry and have children.

III. The next observation I shall make applies to *standing armies and navies.*

As domestic service debars eligible women from marriage, so does military service debar eligible men.

In old times soldiers were called out for a single campaign. And, if they survived it, they returned to their homes and became domestic men, and fathers of families. Now, they are sent to distant lands and unhealthy climates, or are immured in barracks wherein celibacy is almost a condition of their service. In either case they are thus well nigh withdrawn from the matrimonial market. And this enforced celibacy robs the nation of its finest men—those who should have been most encouraged to marry and become fathers of families.

Nor is it only in respect of those who are taken away that military service is prejudicial. It acts also prejudicially in another way, at least in the case of the higher and middle classes. For the elimination of the more attractive men gives to the weak and feeble who remain at home a better facility for marrying; which, if they used by choosing for themselves the most gifted women, would so far neutralize the evil. But that is what they do not do. Such men are shy and afraid of being refused, and, therefore, they take a passive rather than an active part. Instead of seeking out the women whom they prefer, they accept the women who seek them out. They also shrink from the idea of marrying wives whose attractions may hereafter give them cause for jealousy, and they prefer the advantages of fortune and rank which are not accompanied with the same drawback. Besides which, they live much at home under the influence of their mothers and sisters, who naturally wish them to make good positions in life rather than seek wives who have personal attractions only.

IV. The next circumstance I will mention is *the immunity to marry which is afforded to idiots and imbeciles.*

In our Government asylums and many of our union houses idiots are taught trades. And, much to the credit of the teachers who are employed in this seemingly hopeless task, some of them acquire considerable skill in their respective occupations. And so far, is good. But what follows as the consequence of this? Idiots, after being enabled to maintain themselves, are considered no longer objects of charity, and are sent back from the asylums to their homes. The lad who has been taught carpentry returns to his village, and there he marries, and may have a large family. The sempstress also is sent back, to provide for herself by needlework; and she *does* provide for herself, but in a different way from that which was intended. And thus idiots are produced generation after generation.

I hear some one say, "What! would you be unkind to these poor beings?" I answer, "No! but I would not let them produce other poor beings to the detriment of our race."

If the Government takes in hand a helpless child, whom its parents cannot maintain, and provides it with sustenance and comforts, that Government has surely a right to a control in its subsequent actions. And, I think, it is not too much to ask that the Government should thus continue a control over the persons

whom it has maintained, until they have passed the marriageable age. A stipulation might be made with the parents to that effect. Nor can it be said that such a proceeding would be out of character with the usual course of our legislation. We live under a paternal government, which, free and liberal as it is, never hesitates to exercise its power when the true interests of its children are concerned. The Parliament which passed the Contagious Diseases Acts might certainly find a way to prevent idiots from marrying and having children.

Thus I have mentioned some circumstances connected with our social organization which I think likely to affect the well-being of our race. Many others will, no doubt, occur to your minds, though they have hitherto attracted only occasional notice, and have not been followed out by any systematic inquiries. Such, for instance, as consanguineous marriages, mental impressions, and human hybridity. But I have need only to refer to them to show that they are not of a nature to be dwelt upon here, and I shall therefore conclude with one practical remark.

Seeing that our minds and bodies and dispositions are derived from our ancestors, it is, I contend, a duty incumbent on every human being to select for his or her partner one whose ancestors have been free from bodily and mental defects, at least as far as these can be ascertained. And, therefore, it is the duty of the State to make accessible all possible means of information which can assist them in their researches, so far as is consistent with individual liberty. The registers, for instance, might present many more facts than they do at present.

The birth register might contain not only the name and surname of the child's parents, with their rank or profession, but also the maiden name of the mother, her age, and the number of children she has previously borne. The death register likewise would be far more useful if it gave the maiden names of deceased women as a help in tracing their pedigrees; and there might be a general register of diseases, in addition to those which name causes of death. This latter plan has been found highly valuable in the conduct of life assurances, and there can be no valid reason why the world at large should not have access to similar records. So much, in truth, has the plan met with the approval of medical men that it has already formed the subject of a petition; and, notwithstanding the difficulties which are in the way of carrying it out, it will most likely be adopted before many years are passed.

Further with regard to the census, the paragraph in the householder's schedule in which Government promises to observe secrecy might be omitted. The promise was needful when the census was a new institution, because it was thought that people would be reluctant to give answers unless some such precaution were taken. But now that it has become a recognized institution, and people know by experience that no harm will ensue from answering inquiries and that refusal means penalty, they give information readily.

Supposing then this promise of secrecy be omitted, and the

census be opened to public inspection and be made quinquennial instead of decennial as now, and a system of photography be connected with it—a plan which is not impossible, looking to the extraordinary progress which photography has made as well in cheapness as in excellence—the tables in connection with the registers will offer a vast boon to the public. For every man purposing to unite himself with a family would, by aid of these documents, pictorial or otherwise, be enabled to discover the antecedents of that family; and a father whose daughter's hand was asked in marriage might save his posterity a world of suffering by some fact he happened to ascertain through the same means.

I am well aware that if all these improvements were carried out a very small number of persons would yet avail themselves of their benefit—as indeed it is only a very small number who turn to any public boon which does not coincide with the fashion of the times. But a day may come when hereditary influence will be as much considered in relation to human beings as it now is in reference to sheep and oxen, and when what I have named may be the means of saving posterity, as far as its material existence is concerned, a world of suffering both mental and bodily.

E. WYATT-EDGELL.

The following papers were also read in this Section:—

"On Simplicity, Common Sense, and Intelligent Supervision in Sanitary Appliances," by Mr. PETER HINCKES BIRD, F.R.C.S. (C.S.S., Cantab.).

"On Nature's Hygiene," by Mr. F. C. KINGSETTE, F.C.S.