space ; but after four hours' continuous compression, severe pain again put a stop to treatment ; and though pulsation in the tumour had ceased, it shortly returned, the opinion being that, although circulation through the femoral was controlled, a free supply of blood entered the sac through the collateral branches. It was then determined to try the effect of Esmarch's apparatus, not so as to empty the sac of blood, but keeping it filled, so to cut off all circulation through the limb as to allow of the coagulation of the contents of the sac. The limb was enveloped in the bandage from the toes upwards, but the bandage was passed very lightly over the knee, so as to exercise little pressure on the sac, and the thigh was then enveloped to the middle third. The elastic ligature was passed round the thigh, and kept on for fifty minutes, when pain above the seat of the constriction necessitated its removal. It was then found that all pulsation had ceased ; the aneurismal tumour was hard, and, as a means of precaution, a tourniquet was applied, at intervals, over the femoral for a few hours longer, to moderate the current of blood through the artery. Pulsation never returned, however, and the man when seen some months afterwards was perfectly well. The striking feature in this case is the rapid cure. One can readily understand stagnant blood, in a vessel in a limb almost deprived temporarily of vitality, speedily coagulating ; but it will be observed that this is not precisely the method of cure which we have been in the habit of considering the most desirable in aneurism. The efforts of surgeons, from John Hunter's time, has been so to retard the flow of blood as to encourage the deposition of laminæ of fibrine till a sac becomes filled. In his address in surgery at Birmingham, Mr. Pemberton says : "What we want is a stream of blood flowing into the aneurism, that it should be more or less retarded there, and that there should be present something of the nature of a foreign body—for example, the fibrous laminæ—on which blood would coagulate and deposit its fibrine, for I strongly hold that what we want in these cases is a deposition of fibrine rather than a coagulation of blood. Surely, the slow deposition, layer after layer, of solid fibrine in the sac, until filling in is complete, is a surer guarantee against future mishaps than if it were closed by a mass of suddenly coagulated blood." Now, whilst fully admitting the soundness of the views here expressed, I still consider this case well worthy of the attentive consideration of the surgeon. Certainly, I would prefer the gradual consolidation of the aneurismal sac by the deposition of fibrinous laminæ ; but I am sure I have seen cases in which, either from the shape of the aneurismal swelling, or from the briskness of the collateral circulation, attempts to obtain consolidation by retarding the flow of blood have been useless ; and, again, the pain induced by long-continued compression, or the nervous irritability of the sufferer causing him to be intensely sensitive to pain, may thwart our efforts to produce this gradual consolidation. Without presuming to draw conclusions from a single case, I still venture to bring this interesting one before the members of our Association, affording as it does another and a novel illustration of the benefits conferred upon surgery by Esmarch. And if further experience prove that, in cases where we fail to obtain the gradual consolidation at which we have hitherto aimed, we can obtain rapid and lasting coagulation by actually stopping circulation in a limb, we shall have made another very important addition to the methods already in use for the cure of aneurism.

Gentlemen, I feel I have already trespassed long enough on your patience. I wish my crude and imperfect remarks had been more worthy of your consideration. I have been able to tell you little that is new, and nothing that is original. It is given only to the gifted few to originate ideas and introduce innovations. But still I may hope to have completed a far from useless task if I have succeeded in interesting this large representative gathering, in even one or two important surgical questions ; for it is only by the accumulation of facts, and by the interchange of experiences, that we can hope to throw light upon those delicate and difficult problems in which the profession we love so well abounds.

Wholly occupied, as many of us are, in the pressing practical work of our profession, too little time can frequently be devoted to the scientific and more attractive side of it ; and yet the humblest worker in our great field of labour, diligently and conscientiously doing his daily work, may reap a rich reward ; for, even before wealth and honour, welcome as they are, is the gratitude of our fellow-men for benefits conferred upon them, and the peace that comes from a life spent in trying to alleviate the sufferings of our fellow-creatures.

A REPRIEVE arrived in Leicester, on Saturday night, for the culprit Cornelius Asher, aged 77, herbalist, sentenced to death by Mr. Justice Field, at the recent Leicester Borough Assizes, for the murder of Ann Gee, on May 2nd, and whose execution had been fixed for Monday morning.

ADDRESS IN PUBLIC MEDICINE,

BY

ALFRED CARPENTER, M.D., C.S.S.CAMB.

A PARLIAMENTARY leader has spread far and wide the proposition : *Salus populi suprema lex*. We are bound to believe that, when he uttered that sentiment, he honestly gave adhesion to the principle involved in it. Nay, the harassing legislation which a belief in its correctness helped to promote, has assisted to bring about the ebb-tide in the promotion of sanitary work which we are now witnessing. It may be thought that a proposition which has become a proverb, cannot be accepted as an axiom ; the epitome of abridged wisdom which is wrapped up in its meaning being lost sight of. Such is the proposition to which the then Prime Minister gave utterance nearly three years ago, and which should be the watch-word of the Health Department of this Association. The questions which are involved in the proposition are manifold, and their prosecution by the members of the medical profession has produced a greater number of enemies than it has brought friends.

Ebb-tide in sanitary work, however, is not to be wondered at. Terence wrote in ancient times :

"Obsequium amicos, veritas odium parit";

and as in times of old so it is now, obsequiousness has no place in the performance of duty, and as a natural consequence its prosecution promotes opposition. It is my present purpose to show why opposition is attended with so much apparent success, to point out simple lines of progress, and propound a theory as a basis for continued exertion.

It is scarcely more than forty years since the first national platform was established upon which satisfactory observations could be made, and successful operations carried on in the cause of preventive medicine. The statistics which have been prepared by William Farr, have been true pioneers of sanitary work. I would by no means decry the observations made by the older sanitarians. Howard and Pringle, Harvey and Jenner, with many other older workmen, are worthy of the highest regard by those who value the work in which we are engaged, and who think prevention of greater national importance than cure. If it had not been for the work of these eminent men, followed as it was by that of the enlightened politicians who framed and passed the Factory Act of 1833, and the Registration Act of 1834, William Farr's records would not now be matters of history, and we might still be groping in the dark as to the natural laws which regulate the health of the people, and be theorising as to the causation of disease, instead of calling upon Parliament to legislate for its prevention. The facts which have been brought to light by Farr's tables, the enormous mortality which has been shown to exist in defined districts, among defined classes of persons, and at particular epochs in their lives, together with the philosophical and suggestive papers which have been prepared by, or at the suggestion of, one who deserves as much of his country as any living man—I mean John Simon—have led to a flood of legislative measures, sometimes contradictory, passed in paroxysms ; too often spasmodic in their character and unsatisfactory in their working ; culminating at last in the enactment of a measure, which made the appointment of medical officers of health compulsory upon all local sanitary authorities. This measure has laid a foundation which enables us to apply particular observations to defined localities all over the country. The compulsory appointment of those medical officers was preceded by a permissive stage—permissive, first, in the application of sanitary work to a particular district—permissive, in the way in which that work should be applied, but at the same time accompanied by the stern resolves of the courts of law that, in applying those works, and bringing them into practice, the rights of individuals should be respected. The antagonism between the *suprema lex* and the liberty of the subject ; the opposition between *salus populi* and the rights of property, continued to throw serious impediments in the way of sanitary progress, because the truths of sanitary science were few, whilst the *ipse dixit* of its professors, both medical and engineering, were numerous and contradictory. Especially has this been the case with the comparatively new profession of sanitary engineers, a profession which has sprung up to execute the works which sanitary science has called for ; the members of which profession, in a large number of instances, were ignorant of natural science. Is it to be wondered at that Parliament in its wisdom passed permissive

measures? Is it not a natural thing that those who had faith in the truth of their dogmata should ask for a trial of the principles they wished to be carried into practice, before making it compulsory on local authorities to entertain them? Was it not natural that those who desired healthy and satisfactory progress should prefer to see the suggested enactments in operation, and that they would wish to have an opportunity of studying their effects, before committing the legislature to a course of action which would have to be retraced if it happened to be projected on wrong lines?

Hence the value of permissive measures; the promoters of antagonistic schemes for the improvement of the health of the people have had a fair field: the principles upon which these schemes are based may have been correct, but unfortunately the advice of the medical expert has been but too often only half acted upon. The principles which govern the application of sanitary law have been only half understood by those who have had to carry them into practice, and have been only half applied. Medical men are not acquainted with the first principles of engineering work. To engineers has been most naturally intrusted the duty of devising and carrying out the works which were required for the removal of the causes of disease, with the too frequent result of partial failure in effect, because sanitary law or a study of biology have not been the guiding stars of the engineer; whilst the medical adviser, being totally ignorant of the requirements of the former, has unwittingly passed over serious defects in the proposed schemes. The lesson which has been learnt is, that medical officers of health must know something of the first principles of sanitary engineering, so that they may be able to detect any grave defects in the works which a local authority may determine as requisite to be carried out in a given district. Such first principles must be a part of the education of everyone, so far as they are connected with drainage, water-supply, and building construction.

Registration of the causes of disease tells us in conclusive figures that disease is irregular in its incidence; that it coincides in its incidence with certain social conditions; that certain forms of disease decrease or increase as those social conditions alter for the better or for the worse. The study of the statistics of a given locality is a mariner's compass to the student in prevention; whilst the rise and fall of certain forms of disease in that locality constitutes a barometer whose daily readings point out to the pilot the course which he should steer, and advises him of coming storms. It is only recently that every place has had its recognised pilot, whose duty it is to watch the indications afforded by registrations, and to advise the local authority accordingly. The indications are, however, not afforded to that officer at the most important and essential time, viz., at the very onset of epidemic or infectious disease. Registration of death is not in itself sufficient for the welfare of the state. The only information which a medical officer of health receives officially at present is, that disease of an infectious character has been fatal in a given place some time previously. This information is conveyed to him many days or even weeks after the event, and he finds, on inquiry, that the *matrices morbi* has already been spread far and wide, that the contagia which have been produced by that case have been passed into the public sewer, the nearest water-course, or other receptacle for human excreta, and, as a consequence, have most likely multiplied indefinitely. It is also probable that many cases of the same kind occurred before one was fatal, and that no efficient steps were taken to localise or circumscribe the effects of the disease in that locality. It is more than probable that if the proper officer could have had information of the first appearance of that disease in the locality, the general distribution of its contagious particles would have been prevented, and the people saved some of the consequences of that distribution. A natural sequence to the registration of death is the registration of these forms of disease, for the repression of which a sanitary organisation is by law established. That registration will be effected in due course. It is a coming wave of legislation, waiting for the time when the natural history of those diseases which it is intended to encounter is more fully understood by the public, and more perfect knowledge obtained by ourselves, as to the way in which preventive measures are to be used. We must be agreed among ourselves as to the proper steering course, before we can have sufficient influence with the legislature to procure the enactment of a satisfactory measure. We must be agreed as to the class of disease which should be registered, and agreed also as to the persons who should give the information to the registrar. I cannot support the opinion that it is our duty, as a profession, to give information on this point. A medical man, or, indeed, any other person, is out of place in undertaking a duty which may follow upon, but which is not a part of, the work he is asked to perform by his employer, especially if that work appear to be to the detriment of the latter. It would be morally wrong for a medical adviser to conceal the nature of a given case, if of an infectious character,

from the knowledge of his employer or the responsible head of the establishment in which his employer resides; but, the medical man having communicated that knowledge to him, the latter should be the party to give the information to the State, and be responsible to the local authority if he withheld it. The members of our profession cannot claim the protection of privilege in any case. If called upon, they would be obliged to convict the employer of neglect if the latter failed to comply with the requirements of the law, if such should be enacted. The employer, or the person responsible for his welfare, should give notice, just as at present the owner of cattle is bound to send information to the inspector that disease of a certain kind exists on his farm. It was felt, when the Contagious Diseases Act was passed, that to call upon veterinary surgeons to give the required information would defeat the object of the Act. It would no less defeat the object in the case of human beings if medical men were to be called upon to forward the information to the local authority; there would be an immediate premium on the employment of unregistered persons, and an effort made to suppress the discovery; and unless medical officers of health are to be entirely restricted from private professional work, it is quite impossible for such an enactment to work satisfactorily to the State, whilst, under any condition, it would be unjust to the private practitioner.

The progress which has been made in recent years in the repression of disease is marvellously great. The compulsory measures which are already on the statute book are extensive. The various factory acts, nuisance removal acts, registration, vaccination, and adulteration of food acts, acts for regulation of lodging-houses, of water-supply, and numerous other fetters which are placed upon disease-production, both afloat and ashore, are very galling to a large portion of those affected by them; they are restive under the yoke, and will not understand the reason why those acts have been enacted. As a consequence, the unwritten and unexpressed object of our legislators is to prevent the rigid application of the laws of health to their own particular locality. It is true that many among them are energetic, but many too frequently follow the shadow rather than the substance, they raise some question on some trivial side-issue, and make a strain at a gnat, but on great questions, which affect themselves, they swallow the camel with the greatest ease. No better illustration of the truth of this proposition could be afforded than the action of a portion of those persons who have been recently agitating for a so-called Vivisection Bill. Some of these persons are permitting cruelty of the most excruciating character to be daily inflicted on their flocks and herds. They allow castration and other painful operations to be performed in the most painful manner on all classes of animals on their estates. They allow the cottages of their poor tenants to continue in a condition in which morality and chastity are impossibilities; whilst drunkenness, wife-beating, and child-murder are the natural sequences to such states of habitation. These things go on every day before their eyes. They have the power to prevent them, but they do not; yet they do raise their voices in shrill clamour against comparatively humane actions which they do not understand, which have for their objects the diminution of suffering in the future, and an elucidation of the truths of physiological and pathological science. The truths of those sciences are so telling against certain forms of quackery and delusion, that it is not surprising to find the supporters of quackery among the promoters of the Vivisection Bill. They would stop the study of physiology if they could, for it deals death blows at the —pathys and —isms in which they delight.

I would not, however, have it considered that we are in favour of the cruelty which is said to be practised by scientific students in demonstrating physiological facts. When I was myself a student, I was never cognisant of such, and I believe that the statements are gross libels on our profession—libels which are quite unworthy of any Government to have countenanced, and are an indication of a desire on the part of some of the ruling powers to put a slight upon science, and especially upon that profession which includes among its members a large portion of the searchers after the hidden truths of nature.

An idea is now present in the minds of the ruling powers that they do not intend to be doctor-ridden. They have done a great piece of satisfactory work; they have made the appointment of Medical Officers of Health compulsory. Some local authorities have even conscientiously performed their duty, and have appointed efficient officials.

The medical officers so appointed have zealously set to work to find out the sanitary defects which exist in their district, and have made elaborate reports regarding the same. Many are astonished to find that, although appointed to do certain work and to make certain suggestions for action, no action is taken, and things remain much as they were before the appointment was made. There is nothing very extraordinary in this. It is the rule in every-day life. The custom of the unit is necessarily the custom of the aggregate of units; and the local authority

does that as a body, which the majority of individuals comprising it do in their daily life. It is the same result which naturally follows when a medical man offers his gratuitous advice to his wealthy patient at the wrong moment. The country is now passing through a phase of this kind; honest and conscientious medical officers of health are bringing down upon themselves a shower of indignant remonstrances, of wide-spread abuse and energetic opposition from local John Bulls, who do not recognise the fact that the State is suffering from mischiefs which can be removed if proper measures be taken for their removal. The reports of medical officers of health lie on the table, and very little concerted action is taken for the removal of those causes of disease which have been so ably and clearly pointed out. The patient is saying pretty plainly that he does not intend to rigidly obey the laws of health or to be doctor-ridden, and until some wave of epidemic disease arises, and compels him to reconsider his determination, he will not alter his course or take a different line of action; he may then instruct the sanitary engineer to carry out costly works which remove the most flagrant nuisance, but when carried out, they often do not effect all the objects intended, because some first principle of sanitary law is altogether overlooked.

These results, though not due to defects in sanitary science so much as to construction of works, are leading the public to inquire for themselves and to criticise our actions. Fortunately for science, physiology is taught in some of our elementary schools, whilst honours are taken at our universities in natural science by men who do not intend to enter the medical profession. The youth of both sexes are learning more and more the laws of nature and imbibing the first principles of physics. A portion of the public believe that it is the duty of the physician to give a reason for the line of treatment he is pursuing; they will not be satisfied with an evasive answer, whilst the more sensible portion will not be led astray by a false one. Our explanations must be either strictly correct or so framed as to apply to a possible hypothesis, and not be contrary to the laws of natural science. To the medical profession the country owes in a great measure the knowledge which has been obtained of the laws which apply to the prevention of disease. As a profession we must continue in advance of laymen, and we must not allow the idea to gain ground that prevention and cure are different studies, and may be entirely separated from each other. It may be even that one will supersede the other and become the more noble study, but to give currency to the proposal that medical men should not be called upon to consider the means to be used for the prevention of disease, and that they may ignore the operations of the engineer, would be suicidal. We must know how to prevent disease if we would retain the confidence of the public. If we are properly acquainted with the best principles of prevention as well as of cure, our objectors will not be long in finding out that they had much better be doctor-ridden, as they style it, than put their trust in delusions. At the same time, it is our duty to advise, not to dictate, to recommend, not to command, and to support our recommendations by arguments based on sound science. If the doctor be unskilful, addicted to dogmatise, and to advance opinions which are not founded upon scientific truths, he is doing serious harm, and helping to promote those forms of quackery which are so rife among the idle, the self-willed, and half educated ignoramus of society. We require a clear insight into the conditions which give rise to disease, to reduce the principles of preventive medicine to the plainest lines, and to bring it into formula which may be at once assented to; perspicuity being the basis of all true knowledge in every branch of study.

I will set out what I believe to be some of these bases. The first principle of sanitary work is *motion*. Any plan which entails stagnation as a part of its scheme must have the cause for that stagnation very clearly expressed, and a sound reason given for it, or the scheme is bad in design and not calculated to effect the object for which it is proposed. This is a canon law with reference to the first great purpose of the sanitary officer. From the moment of excretion until it is utilised, motion of the excreta is the first sanitary law. If the excreta of carnivorous animals be kept moving, those combinations which produce epidemic disease are not forthcoming. For this purpose, sewers are required in crowded localities. They are the necessary evils which follow upon the aggregation of individuals into crowded communities, though they are quite out of place in the village and the isolated mansion. Any sewer so constituted as to allow stagnation of any of its contents in any part of its course is wrongly made. If arrangements be introduced which necessarily produce stagnation in the air, if only for a few feet of house-drain, a manufactory or vineyard is allowed to exist in which contagious particles may vegetate, and may be the starting point of a fresh epidemic; any trap on a sewer which is not accompanied by a corresponding ventilator may become a trap to catch men. Any sewer so constructed as to allow of deposit of solid

matter, or which allows sewage to stagnate in any part of its course, is in a similar condition. Sewers must contain a current of sewage constantly passing down, with a corresponding current of air always passing one way or the other, if they are to be kept free from the power of manufacturing mischief. Ventilation must be free and absolute, ingress being allowed as well as egress, in a way which cannot be counteracted. For every house in connection with a public sewer there should be at least two free openings provided in the house-drain, an inlet as well as an outlet. If this arrangement be carried out, and the openings contrived so as to effect the object in view, and not for the purpose of defeating it, the natural forces will more effectually ventilate the sewers than any artificial aids. The diffusion of gases, the tension of vapour, the differences of temperature, in the sewer as compared with the outer air, the constant movement of external air, together with the movement of sewage in the sewer, will suffice to produce a free ventilation at all times. If this be done, no contagium particle will have a chance of reproduction in the contents of sewers, and no sewer gas will be discharged which will convey elements of mischief.

Deposit must not be allowed to take place; sewers must flush clean. The engineer who constructs sewers so that a deposit is probable in the invert of the arch has failed to effect the object for which he was engaged, and has erected an elongated cesspool. A sewer must flush clean under all circumstances. If sewage be always moving in the sewer there will not be time for deposit, there will not be time for those changes to take place upon which the production of contagia depend, so that motion prevents evil. Sewage must continue in motion and pass on to its destination. There is another point worthy of mention which is too often forgotten—fresh sewage does not smell. If a sewer stink, it is defective in its workmanship somewhere. It is not sanitary science which is at fault, but engineering work. Sewers which give out unsavoury odours ought not to be accepted. They are defective either in their ventilation or in their levels; they are either wrongly designed or badly executed; and the engineer should be called upon to rectify the mistake.

Sewage cannot be retained in a sewer or anywhere else for more than twenty-four hours without producing a chance of evil; long before that time has elapsed, it ought to be on its way to be utilised. The moment utilisation of sewage has properly commenced, from that moment the evils which might result from sewage recede into the far distance, and it becomes ineffective as a focus of infection. At present, nineteen-twentieths of the sewage produced by the thirty-two millions of Great Britain is cast into the sea, or allowed to decompose after it has set up an immense amount of disease. Some of it becomes food for fishes, but the major portion is lost for ever by its reduction to its original elements.

It is not assumed that the utilisation of sewage by irrigation is possible in every place. It is, however, simply a matter of cost. At the first sewage conference ever held in this country, which took place at Leamington in 1866, evidence was produced which showed the safety and success of the plan when managed by those who understood it. But the resolution which I submitted to the meeting, and which was ultimately carried without a division, stated that, whilst sewage-irrigation was a method of utilisation which would quite prevent the pollution of our rivers, yet there were places to which it was not applicable, and for which some other means of utilisation must be provided. I wish now to show what can be done by irrigation. The Croydon Sewage Farm at Beddington is at this moment utilising the sewage of 50,000 persons on 460 acres of land. It has been in action for sixteen years, and some of the land has been irrigated more or less night and day for the whole of that time. The farm is close to a dense population; it is immediately surrounded by residential property of the most valuable kind. The efficiency of the soil is becoming greater year by year, as the management of sewage land is becoming better understood. The population of the parish in which it is situated, and of which it occupies nearly one-fifth of the whole area, has trebled since the farm was first laid out, an increase of population which is greater than has taken place in any neighbouring village or town. The rateable value in the parish books has risen by reason of the increase of building from £11,000 a year, at which it was rated in 1861, to £36,000 a year, at which it stands now. The death-rate, which averaged 20 in the 1,000 before the establishment of the farm, has not risen above 17 since it has been in operation. The birth-rate is high, tending to raise the death-rate higher than it otherwise would be. Sewage-farming at Beddington has neither depreciated the value of property nor injured life, but has actually acted in a contrary direction. It has also done much more than that. The land, which was naturally poor before it was taken for sewage utilisation, was let at the agricultural value of 24s. per acre. The neighbouring land has, however, risen in value since then, and now lets at £2:10 to £3:10 per acre as market

garden land. But the Croydon local board have been obliged to take the land on lease at the enormous rental of £12 per acre, which is rather less than its cost would have been to us if we had purchased it compulsorily. The landlords, instead of receiving £525 *per annum*, now obtain £5,500 a year without any trouble to themselves; they become rich men, if they were not so before. The farm employs more than three times the number of hands, and raises at least five times the amount of produce. There is at this time upon the farm a herd of nearly one hundred and twenty head of cattle, many of which have been bred on the farm, including fifty milch cows; they are as free from disease and as healthy looking as any herd in any part of the kingdom. Let us bear in mind that the landowners have become rich men, the wages paid have more than trebled, the produce raised has increased by five times; there has been no depreciation of value to neighbouring property, no production of infectious disease or miasmatic influences, but there has been a complete destruction of the contagium-particles which a large population necessarily produces, whilst the effluent water discharged into the river after it has passed over the farm, has seldom been less pure than that supplied to many places as potable water, although I would not, for obvious reasons, be in favour of such water being used for drinking purposes. This result is brought about by continuous movement; from the time the sewage is discharged into the house-drain, until the time when the effluent leaves the farm, is from six to twelve hours. The most important operation which takes place on a sewage farm is the destruction of contagious particles. The moment they are brought into contact with the spongioses on the rootlets of sewage grown crops, as may be easily seen in any field of ryegrass which is being irrigated with sewage, the spongioses seize upon the albuminous matters in the sewage by a kind of elective affinity, including the contagium-particles, remove them from the water, and digest them with an avidity which is most remarkable; no putrefaction takes place, no retrocedent decomposition arises, but the albuminous matter is digested as perfectly as white of egg is digested by the human stomach. Putrefaction is no part of sewage utilisation, and if putrefaction take place, there is a corresponding decrease of productive power, and also a proof that sewage-farming is not properly carried out there. There are three simple rules to be observed. (1.) The sewage must be kept near to the surface of the land, so that the contagium-particles which may be contained therein shall not get beyond the reach of the spongioses of the crop, but shall be digested at once, before they can become reproductive. (2.) The amount of produce removed from the land must bear a constant and regular ratio to that of the sewage put upon it; and (3rd) there must be a rotation of crops, so that the materials common to sewage which one kind of crop does not take out from the land may be removed by another class of vegetable produce.

The utilisation of sewage by agriculture is one of the most important actions which the political economist, as well as the sanitary officer, can promote. It is a large field for the investment of superabundant capital, which must bring a handsome return to the inhabitants of the land in which it is invested, even if the investor fail to get a large premium. If one-tenth part of the sum which has been lost in Turkish, Egyptian, Honduras, and other worthless securities, had been invested in sewage utilisation, tens of thousands of acres of land which are now comparatively useless, might be bringing in a yearly revenue of five pounds an acre to the present owners, whilst the produce raised upon them would assist to reduce the famine price of butchers' meat, and be a boon to the country. It is proposed to spend ten or fifteen millions of pounds in the formation of a channel tunnel, which by a slight accident may be entirely lost. A similar sum expended for the purpose of utilising the sewage of London would make 10,000 acres of barren land as fruitful as the Beddington fields, and could not be lost. Motion in contact with atmospheric air in the sewer, on the farm and from the farm, constitute the first principles of sewage utilisation. I say, in contact with atmospheric air, because this is the *sine quâ non* of utilisation. Even in the next best way of dealing with sewage, viz., by intermittent downward filtration, it is an absolute necessity, although in such case the utilisation is secondary and partial only.

Experience has taught us that in dealing with sewage there are two other canon laws which are simple and absolute in their character, and which cannot be departed from without danger. One has reference to the communication between the house and the main sewer. No matter how careful the architect or the sanitary engineer may have been in his plans, the drainage portion of the work is carried out by a class of workmen who habitually slur over their work, and the common laws of hydraulics and pneumatics are studiously ignored. The natural result is occasional or even frequent stoppage. To obviate this danger, no sewer should have any direct

communication between it and the interior of the house. Such communication should always be by indirect channels only.

The other canon law is also absolute. It is, that no water-pipe conveying potable water for use into any house should ever come into direct contact with a sewer or house-drain in any part of its course, especially at the orifice of discharge. The reckless way in which plumbers and house-fitters disobey these laws is producing danger to individuals in all ranks of society. Sewer-air from imperfectly constructed sewers is laid on to our bed-rooms, dressing-rooms, kitchen departments, and lavatories, as regularly as if it were a necessary of life, whilst the water-pipe is in a thousand of instances so placed as to render it perfectly impossible to be used without the contingency of air finding its way to the water from the impurest of impure sources. People reputed to possess common sense do not see the danger of such proceedings, because every one using water liable to be so contaminated is not affected on all occasions and at all times. They argue that the precaution of keeping water-pipes away from the neighbourhood of sewers is unnecessary, because a fatal result does not immediately follow. They might as well argue that a battle-field is not dangerous, because the hero of a hundred fights died a natural death in his own bed.

I am inclined to make seven distinct classes of zymotic disease, and to include among them several which, at present, are assumed to be peculiar to animals alone. But the classification includes all the diseases which appear as epidemics in this country. The conditions are analogous under which one or other of them may arise, according as a concurrence of circumstances come together or not. The first class includes small-pox, cow-pox, chicken-pox, and sheep-pox. Its reproduction requires a germ or atom of potent matter which must be introduced into the animal economy from without. Now and then an individual is found who is insusceptible of the disease. If we could discover the reason for this insusceptibility, we should get the clue to the means which are required for the entire prevention of small-pox, and even render vaccination unnecessary. Attention to ordinary sanitary detail will not prevent its appearance, though it may diminish its fatality. A person who is apparently most healthy, very cleanly in his habits, who always inhales pure air, drinks pure water, and who is but little exposed to the influence of decomposing fæcal evacuations, may yet suffer from the disease. It is true that it is much more fatal in a dark, ill-ventilated house, with the insanitary surroundings which usually belong to such; still the fact remains, that small-pox is not prevented by sanitary regulations alone, and is not so capable of prevention by municipal and personal cleanliness, as most of the zymotic class.

A distinguished member of this Association has made out that the milder exanthem, cow-pox, acts as a preventive of the severer form of the disease, simply because it is a modified form of small-pox, modified by its transmission through an animal; the germ which produces it having been a germ of small-pox, changed in its nature by passing through the body of the cow. It is an instance of the way in which Providence places in our hands means whereby we may extract the sting of disease if we set about it in the right way. The recipient of the slighter disease is insusceptible of the severer form of malady for a long time; until most of the tissues of the body have been altogether changed, and new matter laid down in their place.

This insusceptibility to take on a similar form of malady a second time is peculiar to most zymotic diseases. A person having suffered from enteric or scarlet fever, is less liable to suffer from that form of disease again. In this they differ materially from constitutional and functional diseases. If a person have suffered once from gout or bronchitis, he becomes more liable to recurring attacks. He has established a custom which will possibly set up an outlet in his system for the discharge of effete or used-up matter. It has one privilege attached to it; there is often a smaller quantity of the particular material in which the germ or potent matter of zymotic disease delights, than in that person who is apparently in a healthier state, which accounts for the fact that delicate people suffer less severely from epidemic maladies than those who are strong and hearty. The manifestation of zymotic disease represents the result of some potent force, or the effect of some living organism acting upon the humours of the body, and altering the condition of the system, which requires years to efface. It removes from the system the whole of the matter in which the active principle of infectious disease can revel; and until production of its particular pabulum takes place that particular disease cannot arise again, because there is no food for the active principle to live upon. I much doubt if this potent force or living organism, take it as we please, could have any effect upon the body, if the recipient were perfectly healthy; if no impurity existed in the fluids of the body; if the blood contained nothing foreign to a healthy and natural state. If this be so, a question arises, as to whence these impurities proceed, and how their effects are to be guarded against. I venture to put forth an hypothesis for

consideration, which will explain much which is difficult to understand on any other view. Some impurities must exist; they are the used-up matter, the result of the act of life, or they may be inherited tendencies, which have resulted from former neglect of sanitary law, and which have depreciated the quality of the stock, and rendered it more susceptible to bad influences. The impurities naturally increase if there are any defects in the sanitary arrangement of the individual corpus. Their presence is of no moment if they are not in excess, and if they are removed from the body as fast as they are formed, or in the course which they naturally follow. Let us represent them by x , in an equation in which the factors x , y , z (as a total) represent any form of epidemic disease. The problem is to assess the value of each factor in the equation. Divide the factors with two parts: centric elements, or those which are proper to the body; and excentric, or those which act upon it from without; x , y , z , may equal zymotic disease of any kind. Let $x = u + e$; u being the used-up material, the formed material of Beale, always in the act of formation, is not foreign matter, and is not in ordinary proportions injurious to life. It is always being diminished as fast as it is formed, by one or other of the excretory organs which exist for the purpose of removing it. If all the excretory organs and all functions be healthy, and all doing their work properly, the body is in good health, there is no excess of used-up material, no *débris* of combustion. If, however, one or other of the excretory organs fail to do its duty, from either overwork or inertness, something is left in the humoral system, and e is added. It becomes a positive quantity, and represents the excess of matter which should have been removed, $u + e = x$. They have a common origin, being the *débris* of the act of living; e will differ in quantity as well as in quality. It will be modified by personal character, by actions, by non-actions, and even by attainments, but especially by attention to or neglect of sanitary and moral laws. Still more will it vary according to the circumstances of the community among whom the person resides, the moral and the sanitary state, or the habitual neglect of sanitary law in which that community may indulge. Thus, a municipal authority who allows overcrowding, foul air, immoral acts on the part of the people, impure water, or bad food, is providing an excess of e , and increasing the danger which may arise from the introduction of the potent principle of infectious disease. If e be absent, x is not complete, and x , y , z cannot arise; x even may be complete from the circumstances I have detailed, but y , z , are still required to establish an epidemic. If z be made to correspond to an atom of potent matter, a germ or living organism, the particulate contagium of any kind of zymotic disease, the multiplying focus of infectious disorder, and one of the excentric elements in the equation, it has to be introduced from without, and is capable of modification according to the character of the soil into which it may happen to be transplanted. Like the *torula cerevisiæ* or the *Penicillium glaucum*, upon which fermentation depends, and without which alcohol is not produced if z do not gain admission to some part of the humoral system, the entity, zymotic disease, cannot arise. Just as *Penicillium glaucum* requires the sugar and the temperature to produce alcohol, so z , the contagium-particle, requires the food upon which it increases and multiplies, as well as certain meteorological states for its proper development. These latter conditions are represented by y . The severity of the disease will depend upon the quantity of e which exists in the factor x . The epidemic will be more or less general and fatal, according to the greater or lesser quantity of e in each individual, not according to the character of z ; z will be reproduced according to the quantity of food in the recipient upon which it can increase and multiply. If e be absent, the effect of z will be nothing, for there is nothing for it to feed upon. If, therefore, personal cleanliness be attended to, if all the excretory organs of the body be properly exercised, if the municipal authority have insisted upon obedience to sanitary law, if moral laws be obeyed in each unit of sanitary work, the effect of z , whenever it happens to be introduced, will be reduced to a minimum, and z may be so dwarfed as to be unable to effect a lodgment, or it may die out entirely. It will be by directing attention to the necessity of diminishing the growth of e that we shall prevent epidemics from spreading, rather than by useless attempts to keep out z ; by correct sanitary administration, rather than by trying to establish an all but impossible quarantine. If e in the factor x abound, and quarantine be not effectual, if z once pass through the cordon, the power of the latter is lost, and all our work in that direction has come to nought. The equation stands thus: $x = u + e$, and represents the used-up material, the result of the act of life; y = the meteorological conditions, such as temperature, moisture, and certain atmospheric states which are required for the rapid increase of epidemics; z = the contagium-particle upon which the nature of the disease depends. The fatality of the disease will depend upon the quantity of e in the factor x . The rapidity of growth will depend

upon certain meteorological states represented by y , but the character of the disease itself will depend upon z . We can diminish x to a minimum by personal, municipal, and sanitary arrangements; we cannot alter y , but we can impede the introduction of z , and prevent epidemic disease, unless it can be shown that zymotic diseases may arise *sud sponte*. As regards small-pox, there is not any difference of opinion on this point. It certainly requires the introduction of z from without, and if the contagium-particle be absent, small-pox cannot arise. It has been clearly shown that the contagium-particle is a living organism requiring certain forms of matter for its development, and if it do not meet with that matter its character is altered, and it is no longer the same entity.

There is a class which includes measles, whooping-cough, influenza, catarrh, and eczema epizooticum, in which z appears to be a germ of living organic matter, most probably of vegetable origin, possibly the fructification of a class of organisms which have recently been called schizomycetous, and which are too minute for separate identification with present microscopical powers. That vegetable matter can produce similar effects, is seen in the action of the pollen of *anthoxanthum odoratum*, and also of the fine powder of *ipecacuanha*. The effect of these reagents upon the mucous membrane is not constant, it only arises in some persons. Year by year we find the persons affected to be more numerous. They probably have e in the factor x , in some form or other in their systems. The action produced is immediate, and it may be likened to that set up by mustard. The latter affects every one alike, in which it differs from hay-asthma. The action produced by fungi is not immediate; there is a period of incubation, a period sufficiently long for the production of an immense multiplication of fungus-growth, and, as a sequence to that growth, the production of a chemical result. Growing fungi produce carbonic acid or other acid or ethereal products; there is always a considerable formation of gaseous matter produced by such growth. This can set up irritation in the tissues, just as formic acid can, if injected under the skin. The germination, and, as a sequence, the multiplication of fungi in acid media, is one of the wheels within wheels often met with in nature, where reproduction is more rapid, because reproduction itself produces material which increases growth. There is a marked difference between the effect of the materies morbi which sets up epidemic catarrh and that of pollen upon mucous membrane. The one is reproductive, the other is not. It is in the result of reproduction that the cause for the catarrh is to be found. In that reproduction, a material is set free which acts in a manner similar to the pollen of the *anthoxanthum*. Those who live in close ill-ventilated rooms, and who object to admit fresh air, are said to take cold when they do so. It is not the fresh air which injures them, but it brings into contact with the patient's mucous membrane some germ from without, or else it disturbs some such in the ordinarily undisturbed part of the room. The fruit takes root and grows in its new home, reproducing itself, perhaps, like cow-pox, under altered conditions, and in that reproduction sets free a material which is the actual cause of the catarrh.

The effect of copaiva in producing a rash similar to, and which cannot always be distinguished from, measles, except by the absence of fever, is a proof that a vegetable product can excite a similar state. It has not been shown that the rubeoloid eruption which sometimes follows the use of copaiva has any protective influence against true measles. An extended series of observations are required to prove this point; and it may be that there is an opening for information which is worth following up. Measles is more generally prevalent in mild damp seasons: it always appears more or less about cleaning time, when old heaps of rubbish are being disturbed, and decaying organic matter from homesteads and farm-yards are being spread over the soil. It appears then as an epidemic, as if there were a sequence in the operation. It is possible that the schizomycetous organisms may be altered forms of some particular mould or smut, altered in the character of their fructification, and altered in their mode of growth by transplantation to a new home; just as the contagium-particle of small-pox is altered by its transit through the humours of the cow. Alterations of this kind do occur: the connection between the *echinococcus* and the tapeworm is a case in point; and it does not follow that the organisms themselves are distinct species which require a continuous existence in that form for their occasional appearance as epidemics. Just as with small-pox, some persons never have measles, or whooping-cough, or scarlatina, though frequently exposed to the influence of the contagion. Whoever discovers the cause of this exemption will confer a boon upon humanity, as in that discovery will follow the establishment of a means for preventing altogether that class of disease.

The class which includes diarrhoea, cholera, dysentery, enteric and intermittent fever, is essentially one of filth-disease, arising from the effects of a sewaged soaked soil, of polluted water or air, rendered foul by

misms, from decomposing organic matter. Wherever any of this class puts in an occasional appearance, diarrhoea is certain to be a regular visitor, whenever the temperature rises above the ordinary standard, and continues high for any time. It has been imputed to the rise and fall of the water-line in the subsoil in connection with the rainfall of the district. A close investigation of conditions under which summer diarrhoea arises in those towns in which it is prevalent—such as London, Leicester, and Berlin—shows conclusively that, although the highest mortality corresponds with the lowest level of ground-water, there is no relative proportion in any other point. A relation does exist between the origin of the disease and heat. The greater the heat the greater the mortality; the lower the amount of moisture in the air, the higher the death-rate from diarrhoea. A fall in the death-rate follows upon the return of atmospheric saturation. The fall in the level of ground-water, the increase of temperature, and the diminution of water in the air, all occur together. Then it is that those who inhabit cellars, underground dwellings, dark ill-ventilated houses, houses in which dry rot is taking place, all places likely to get an excess of carbonic acid in the air, suffer from the disease. Hand-fed children suffer first and most heavily. This appears to prove that the food is the main starting point. The food, when given, is about to undergo some change, promoted by living organisms, which flourish most luxuriantly under the conditions mentioned. They obtain a lodgment in the mucous membrane of the alimentary canal, and destroy the child by destroying the nourishing properties of the food exhibited. Pettenkofer thinks that locality has more to do with the disease than the introduction of any particular germ—that removal from the place will prevent or even cure the disease. He imputes it to some influence produced upon the people by the rise and fall of water in the subsoil. This rise and fall is connected, but it is as a coincidence. The conditions which give rise to infantile diarrhoea are those which promote the growth of certain living organisms. Such growth takes place most rapidly at high temperatures, when evaporation is rapid, and when the underground air has an excess of carbonic acids in its composition, together with the organisms which accompany that excess—conditions which are likely to be in association with a low water-line, conditions which are always followed by heavy rainfalls. The z in the equation $x y z$ = infantile diarrhoea, is some living organism developed by continuous heat, by dry air, excess of carbonic acid in that air, and some other unknown condition. This organism finds admission into the stomach with the food, sets up a fermentation, by which the nourishing power of the food is destroyed; produces an irritating material, which, uniting with x , causes prostration; and, if this be not fatal, the child is starved to death. The localities in which diarrhoea arises are the favoured haunts of cholera and enteric fever, under other meteorological states in which heat and dryness are not contingencies. Pettenkofer considers their origin to be due to local and personal considerations, and believes that quarantine is useless. The conditions which herald the approach of cholera are progressive from place to place. The factor x may be brought in, and the disease produced earlier than it otherwise would if it had to wait for development *sub sponte*. The observations of Dr. Klein have established the coincidence of living organisms and typhoid in a way which is beyond cavil. In solving the power of each member of the equation $x y z$ = enteric fever, we may be certain that the factor z is a living organism capable of reproducing its like in any situation in which fecal contamination has occurred, and in which the products of filth-decomposition are to be found.

Do any of these diseases arise *sub sponte*? The sudden way in which some of them develop sanctions the idea. This is especially the case with enteric fever and scarlatina. Many intelligent and accurate observers have been unable otherwise to account for the appearance of those diseases in given cases. Yet, the ordinary laws of natural history would forbid the suggestion. Growths, apparently spontaneous, are common in the vegetable kingdom, but in no case is it supposed that the growth has taken place without the previous presence of appropriate spores or seeds. The sudden and wide-spread appearance of eczema epizooticum among cattle, or the destruction of potato by potato-blight, seem to be spontaneous, yet those diseases spread by contagium-particles; we may reasonably suppose that the propagation depends upon spores like to *Penicillium glaucum* or *mucor mucedo*. Those spores are to be always found only waiting for a suitable situation to grow and become fertile in a few hours. They are both aerial and aquatic, and produce different results, according to the dryness or moisture of the position in which they are found, and are modified by the acidity or the alkalinity of the media in which they multiply. Bacteria of different kinds are found in one, vibrios in another; why should not those forms produce a potent matter in their growth, capable in itself of producing disease? We know that certain kinds of fish may be eaten to-day with impunity, but to-morrow they set up serious disturbances in

the animal economy. Vibrios to-day may be harmless, but to-morrow they may produce disease. The secretion from the peritoneum to-day may do no mischief; to-morrow an irritative action may arise which will set up a most virulent and infectious complaint. In peritonitis, a most fatal form of infective disease may be set up, and the infectivity arises *sub sponte* because certain circumstances have been altered, and the bioplasm, existing normally in the tissues, has taken on a new action. The germs were there, but, the vital conditions being altered, a comparatively harmless secretion is turned into a virulent poison.

I believe this to be the case with those specific forms of contagion which are multiplied by filth. Scarlatina and typhus, enteric fever and cholera, arise apparently *sub sponte*, because certain germs or foci of potent matter have been altered by the circumstances in which they are placed, and infective power has been added, just as infectivity is produced in the peritoneal secretion by inflaming the membrane which secretes it. The ordinary excreta of carnivorous animals which contain the *débris* of animal food may or may not be so placed as to produce the germ upon which filth-disease depends, just as dry rot may or may not arise in a building, according as to whether ventilation has been provided for and new wood kept out of the fabric. But if those germs be introduced into the human economy, the disease arises and spreads in the usual manner. So again with scarlatina, long continued observation and analogy forbids the idea of an origin, except from some bioplasm finding a suitable soil in which it may develop its poisonous character.

Time fails me to go through the list of zymotic diseases, and show the character of z in each class. There is a close analogy, a continuing alliance, and a similar explanation can be made as to the value of z in each member of the class.

Zymotic disease, in the majority of instances, has its power of producing evil more in the character of the recipient than in the quality of z . Obedience to sanitary law in private life, together with the performance of public duty by local authority will give comparative immunity from epidemic and infectious diseases, and render us in a great measure independent of the trammels of imperfect quarantine.

As zymotic disease has its main impetus in the disregard of duty, those who advocate the performance of that duty must be prepared to encounter opposition and witness an ebb-tide in sanitary work. It is imperfect knowledge on our part which gives strength to opposition. It is our duty to persevere in the prosecution of a more perfect work. Motion as opposed to stagnation, simplicity as opposed to complexity, should be our cardinal points; and if to this we add the peremptory utilisation of animal *débris*, the sting of epidemic and infectious disease will be taken away, and in the words of the Psalmist, "we need not be afraid of the pestilence which walketh in darkness, nor of the destruction which wasteth at noon-day."

It is our duty to strive to reach this point of perfection. It can be obtained only by educating the people as well as ourselves aright, and we must trust to Providence for our reward.

AN ADDRESS

DELIVERED AT THE OPENING OF

THE SECTION OF MEDICINE,

At the Annual Meeting of the British Medical Association,
in Sheffield, August 1876.

By CHARLES CHADWICK, M.D., F.R.C.P.,
Consulting Physician to the Leeds Infirmary; President of the Section.

In the true interests of this Association, I should not have accepted this position; but, when offered it, I could not resist the temptation of meeting my old friends in the West Riding in friendly discussion, and thus manifesting my interest, still strongly existing, in my old profession, though, through circumstances, I am forbidden the exercise of its functions for a time. Again, I wished to embrace, it may be a last opportunity of expressing my opinion, formed through much experience, of the general tendencies of professional inquiry, and to say how warmly I hail the greater attention now paid to therapeutic science, and the registration of facts under this head; in this way remedying the fashion which has prevailed since the days of Forbes's *Young Physic*, a fashion natural, it may be admitted, when remembering the then customs of our practitioners, but, unfortunately, carried to a dangerous and, to the profession, damaging extent. I have noticed this tendency to a restoration of a rational balance in the teaching of Sir J. Paget and many others. We are building up a structure of medical science which, as we are progressing, will require ages to bring to perfection; in the