1882–3.

TRANSACTIONS

OF THE

Sanitary Institute of Great Britain.

VOLUME IV.

CONGRESS AT NEWCASTLE-UPON-TYNE.

1882–3.

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The Institute, as a body, is not responsible for the facts and opinions advanced in the Addresses and Papers published in its Transactions.

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Sanitary Institute of Great Britain.

Formation of the Institute.

The increasing importance attached to Sanitary Science and the recognised position it was assuming in the public mind, appeared to the promoters of the Sanitary Institute fully to justify the formation of a National Society, the object of which should be to devote itself *exclusively* to the advancement of all subjects bearing upon Public Health, In furtherance of the object, a meeting was held at St. James's Hall, on the 13th of July, 1876, at which His Grace the Duke of Northumberland presided, when it was unanimously resolved :—

First—"That in the opinion of this meeting the sanitary condition of this country is still very unsatisfactory, and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of 'Public Health' a Society be now formed, to be styled 'The Sanitary Institute of Great Britain.'"

Second—"That the gentlemen whose names are appended be requested to act as a Committee (with power to add to their number) for the purpose of carrying out the previous resolution and of reporting to an adjourned public meeting to be held during the second week in October next."*

The Committee appointed to report upon the subject considered it would add greatly to the usefulness of the Institute if Mayors of Boroughs, Chairmen of Local Boards, Sanitary Authorities, Medical Officers of Health, and all who have to administer the Public Health Acts, would associate themselves with the Institute, either in their individual or corporate capacity, and take part in its proceedings. By thus bringing their united knowledge and experience to bear upon Sanitary matters, the laws relating to the same would become better known and be more efficiently administered.

Basis of the Constitution of the Institute.

Section I.

Charter of Incorporation, Membership, and Government of the Institute.

As soon as practicable a Charter of Incorporation shall be obtained, as it will facilitate some portions of the work of the Institute, more

* An adjourned public meeting was held on the 14th of March, 1877, when the report was unanimously adopted and a Council subsequently appointed to carry it into effect.

especially the examinations as set forth in Section II. Until a Charter is obtained, the examinations shall be continued as heretofore, and a Register of persons certificated as competent to act as Local Surveyors and Inspectors of Nuisances shall be formed.

The Institute shall consist of Fellows, Members, Associates, and Subscribers.

Fellows shall be elected by ballot by the Council, and shall include scientific men of eminence, persons of distinction as Legislators or Administrators, and others, who have done noteworthy Sanitary work.

All Fellows (except those who have already become Life Members) shall pay a fee of Ten Guineas on taking up the Fellowship, and such fee shall entitle the Fellow to all the privileges and advantages of the Institute for life without further payment.

Any person proposed by three Fellows or Members, shall be eligible for election as a Member of the Institute.

Members shall be elected by ballot by the Council, and shall be eligible to serve on the Council, and to vote at all Elections and Meetings of the Institute. The admission Fee payable by a Member shall be Three Guineas, and the Annual Subscription Two Guineas.

Medical Officers of Health and Medical Men holding Certificates in Sanitary Science from any University or Medical Corporation shall be entitled to be enrolled as Members of the Institute without Admission Fee.

Members desirous of becoming Life Members may do so on payment of Ten Guineas in lieu of the Annual Subscription.

All persons who have passed the Examination and received the Certificate for Local Surveyor from the Institute, shall, by virtue of having so passed, become Members of the Institute upon the payment of Five Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Any one proposed by two persons, either Fellows, Members, or Associates of the Institute, shall be eligible to be elected as an Associate of the Institute, the election to be by ballot by the Council. The Admission Fee payable by Associates shall be Two Guineas, and the Annual Subscription One Guinea.

All persons who have passed the Examination and received the Certificate for Inspector of Nuisances from the Institute, shall, by virtue of having so passed, become Associates of the Institute upon the payment of Three Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Persons of either sex, interested in the advancement of Sanitary Science, shall be entitled to be enrolled as subscribers on payment of One Guinea annually. Annual Subscribers shall be entitled to attend and to take part in the discussions at all meetings and Congresses of the Institute, and shall have free admission to the Conversazioni and Exhibitions of Sanitary Appliances held in connection with the Institute, so long as they continue to pay their Subscription.

Donors of Ten Guineas and upwards shall be entitled to be enrolled as "Life Subscribers," with all the privileges and advantages of Annual Subscribers without further payment.

Subscribers of Half-a-Guinea to any Congress of the Institute shall be entitled to a card of admission to the Meetings, Addresses, Conversazioni, Excursions, and Exhibition held in connection with that Congress.

The Institute shall be governed by a President, Vice-Presidents, and a Council of Twenty-four, consisting of Fellows and Members of the Institute, of whom not less than two-thirds shall be Fellows. The Council shall be chosen by the Fellows and Members. One-fourth of the Council shall retire annually, and shall not be eligible for re-election for one year.

The first President of the Institute shall be His Grace the Duke of Northumberland. Future Presidents and Vice-Presidents shall be elected by the Council. The Council shall have the power of electing Honorary Members of the Institute, Honorary Foreign Associates, and Corresponding Members of the Council.

Section II.

Objects of the Institute.

To devote itself to the advancement of Sanitary Science and the diffusion of knowledge relating thereto.

To examine and to grant Certificates of Competence to Local Surveyors and Inspectors of Nuisances, and to persons desirous of becoming such or of obtaining the Certificate. The Examinations shall be held at such times and in such places as the Council may direct.

A Board of Examiners shall be appointed by the Council; such Board shall consist of gentlemen representing Medical, Chemical, and Sanitary Science, Engineering, Architecture, and Sanitary Jurisprudence.

The Examination for Local Surveyors shall include a competent knowledge of the Statute relating to Sanitary Authorities, of Sanitary Science and Construction, and of Engineering.

The Examination for Inspectors of Nuisances shall comprise the elements of Sanitary Science, together with Sanitary Construction, and the Statutes relating to the prevention of disease and the suppression of nuisances injurious to health.

Fees shall be charged for the Examinations, and a Certificate of Competence, signed by the Examiners, shall be granted to successful candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

A Congress shall be held by the Institute for the consideration of subjects relating to Hygiene at such times and places as the Council may direct.

Exhibitions of Sanitary Apparatus and Appliances shall be held from time to time as the Council may direct.

Fellows, Members, Associates, and Subscribers shall have the right of Free Admission to the Exhibitions of the Institute whenever they are open. All fees payable by Exhibitors and the Public shall be fixed by the Council and belong to the Institute.

A Catalogue shall be published under the direction of the Council as a permanent record of the Exhibitions.

The Institute shall take such steps as may be within its power to obtain a complete registration of sickness, especially of preventable diseases.

The Institute shall endeavour to secure the services of medical men and others specially qualified to give lectures on subjects relating to the prevention and spread of disease.

The Institute shall encourage the formation of classes for technical instruction in Sanitary Science in such a way as may seem advisable to the Council.

A Library shall be formed in connection with the Institute.

CONGRESSES AND OFFICERS.

TABLE showing the places at which the Congresses of the Sanitary Institute of Great Britain have been held; with Presidents, Presidents of Sections, and Honorary Local Secretaries and Treasurers.

PRESIDENTS.	PRESIDENTS OF SECTIONS.	HONORARY LOCAL SECRETARIES & TREASURERS.
1877.-B. W. RICHARDSON, M.D., LL.D., F.R.S., Leamington, October.	EDWIN CHADWICK, C.B. GEORGE WILSON, M.A., M.D., F.C.S. BRUDENELL CARTER, F.R.C.S.	J. THOMPSON, M.D. JOSEPH. S. BALY, F.C.S. T. H. THORNE, J.P.
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1879.-B. W. RICHARDSON, M.D., LL.D., F.R.S., Croydon, October.	ALFRED CARPENTER, M.D., S.SC.CERT.CAM. CAPTAIN DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S. G. J. SYMONS, F.R.S.	H. J. STRONG, M.D. ROBERT HALL. SAMUEL LEE RYMER.
1880.—The Right Hon. EARL FORTESCUE, Exeter, September.	PROF. DE CHAUMONT, M.D., F.R.S. R. RAWLINSON, C.E., C.B. SIR ANTONIO BRADY.	E. J. DOMVILLE, M.R.C.S.E. H. P. BULNOIS. M.INST.C.E. W. G. ROGERS.
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The next Congress of the Institute will be held at Glasgow, September 25th to 29th, 1883.

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LIST OF AUTHORS AND CONTRIBUTORS.

Armstrong, H. E., m.r.c.s, Newcastle-upon-Tyne.

Bartlett, H. C., ph.d., f.c.s., London.

Carpenter, Alfred, m.d., s.sc.cert.cam., Croydon.

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Price, John., Newcastle-upon-Tyne.

Richardson, B. W., m.d., ll.d., f.r.s., London.

Robins, E. C., f.s.a., f.r.i.b.a., London.

Robinson, Prof. Henry, m.inst.c.e., London.

Russell, The Hon. F. A. Rollo., Richmond.

Yates, Miss, London.

INTRODUCTION.

The Fifth Congress of the Institute was held at Newcastle-upon-Tyne, by the invitation of the Mayor and Corporation, from September 26th to 30th, 1882. The Address of the President and the Lectures to the Congress were delivered in the Town Hall; the Sectional Meetings were held in the Lecture Room of the Free Library, New Bridge Street.

The Inaugural Address of the President, Captain Douglas Galton, was delivered on Tuesday evening, Prof. F. de Chaumont taking the chair, in the unavoidable absence of Earl Fortescue, the President of the last Congress. A Lecture to the Congress was delivered by Prof. F. de Chaumont on Thursday evening, and Dr. B. W. Richardson addressed the working classes on Saturday evening.

The meetings for the reading and discussion of Papers submitted to the Congress were as usual divided into three Sections, viz.: Section I., Sanitary Science and Preventive Medicine, under the Presidentship of Dr. Dennis Embleton. Section II., Engineering and Architecture, presided over by Professor H. Robinson, Vice-President of the Section, the President being detained in London by ill health. Section III., Chemistry, Meteorology and Geology, under the Presidentship of Dr. Arthur Mitchell: these meetings occupied the Wednesday, Thursday and Friday, one day being devoted to each Section.

A Public Luncheon was held on Tuesday afternoon. A Conversazione was given by the Town on Wednesday, and a Public Dinner on Friday evening.

Several Excursions were arranged during the intervals of business, viz., to Sir W. Armstrong's Works; to Messrs. Palmers' Iron Works; the Works of the Tyne Commissioners and the "Wellesley" Training Ship; to the Old Castle; and to the village homes at Whitley.

On Saturday the Duke of Northumberland invited the Members of the Congress to lunch at Alnwick Castle, and the Members were much interested in viewing the castle and grounds, under the guidance of Dr. Bruce.

The Exhibition was held at the Old Tyne Brewery Buildings, Bath Lane, and remained open from September 26th to October 21st.

The Exhibition was in many respects decidedly the best, although not quite the largest, that has been held by the Institute, and the Report of the Judges shows a very large number of awards.

The Congress this year will be held in Glasgow, an invitation from the Lord Provost and Town Council having been accepted during the Meeting at Newcastle. The Council have also accepted an invitation to hold a Congress at Cheltenham in 1884.

E. WHITE WALLIS,

Secretary.

March, 1883.

Congress at Newcastle-upon-Tyne, 1882.

INAUGURAL ADDRESS

By Douglas Galton, C.B., Hon. D.C.L., F.R.S., &c., &c.

PRESIDENT OF THE CONGRESS.

In the name of the Sanitary Institute of Great Britain, I beg to thank you, Mr. Mayor, and the Corporation of Newcastle, for the invitation you have given us to visit this important industrial metropolis of the north of England—an invitation which is the more satisfactory to us because Newcastle is advancing in the van of sanitary improvement, and is thus proving the interest of this great city in a subject which is contributing so largely to the material and moral progress of the nation.

I venture to think that of all the definite questions which are made the subject of instruction by Congresses at the present time, there is scarcely one which deserves a greater share of attention than that which calls us together here to-day—I mean the subject of the Public Health.

Within the last half century the whole community has been gradually awakening to the importance of a knowledge of the laws of health; and the energies of some of the ablest intellects, both of this country and of the world, have been employed in investigating the causes of disease, and in endeavouring to solve the problem of the prevention of disease.

There is no doubt much that is still obscure in this very intricate problem, but the new light which is being thrown day by day upon the causes of disease by the careful and exact researches of the chemist and of the physiologist, is gradually tending to explain these causes and to raise the science of hygiène, which may be translated into the science of the prevention of disease, out of the region of speculation, and thus enable it to take rank as one of the exact sciences.

The sanitarian has known long ago, by the careful observation of facts, that the preservation of health requires certain conditions to be observed in and around our dwellings—conditions which, when neglected, have led to outbreaks of epidemic disease, from the days of Moses to the present time. But whilst the results have long been patent, it is only in recent years that we have obtained a clue to some of the occult conditions in air and water which enable us to distinguish their comparative purity, and which exercise such a powerful influence upon our health.

The researches of Pasteur into the causes of certain forms of disease in French vineyards opened out a fruitful field of enquiry, in the cultivation of which many leading physiologists, chemists, and physicists, are now assiduously occupied; and we have to thank the theories of Dr. Bastian on spontaneous generation for the beautiful series of experiments on bacterian life devised and made by Dr. Tyndall.

In a lecture on fermentation delivered by him not many years ago, he remarked that the researches by means of which science has recently elucidated the causes of fermentation have raised the art of brewing from being an art founded on empirical observation, that is to say on the observation of facts apart from the principles which explain them, into what may be termed an exact science.

In like manner, if recent theories on the propagation of disease by germs, were proved to be correct, and if the laws which govern the propagation or destruction of those germs were known, the art of the physician would be raised from dependance on empirical observation into the position of an exact science.

A large band of the leading scientific men, both in this country and over the whole world, are devoting their energies to a knowledge of these questions; but as yet we stand barely on the threshold.

These researches have shewn us that putrefaction is only another form of organized life. If on a bright day the shutters of a room be closed, and a single ray of light be allowed to penetrate, the ray will reveal the presence in the air of moving particles of fine dust. Dr. Tyndall showed us that germs of the low forms of life, which cause putrefaction, are ever present in this dust; and that they are ready to spring into life and assume activity when a "nidus" is provided which is favourable to the development of the organism.

Lister has turned this knowledge to useful account. In the practice of surgery it was well known that if the skin were cut or broken and the injured tissues underneath exposed to the air, suppuration would ensue; but that when the injury to the tissues occurred under the skin, or if an operation were finished with rapidity, and the wound were sealed so that there could be no access to the air, the injury healed without suppuration.

Lister judged that the suppuration was due to the presence of germs in the air; and in his system of antiseptic treatment he provided for filtering the air through carbolic spray, in order to remove any germs or organisms from that portion of the air of his wards which came in contact with the wounds, and thus to prevent the germs from reaching the wounds, and from developing those organisms whose presence causes what we call suppuration or putrefaction. This treatment has obtained a large degree of success, and has had a very material influence on the art of surgery throughout the world.

The researches of the physiologist have further been directed to ascertaining whether there are not some diseases at least which arise from the presence of minute organisms in the blood. Pasteur has attributed to this cause a certain disease in silk-worms. Dr. Davaine asserted that splenic fever in cattle is due to a similar cause. Dr. Klein alleged that pig typhoid arose from an organism which he succeeded in cultivating; and Mr. Toussaint has attributed fowl cholera to a similar cause. Professor Koch, from the light afforded by recent investigations, attributes tubercular disease to specific germs; and Dr. Vandyke Carter has endeavoured to establish the connection between the presence of bacillus spirillum and relapsing fever. Mr. Talamon claims to have discovered that diphtheria is due to an organism by means of which the virus can be conveyed from men to domestic animals, and *vice versâ*.

Drs. Klebs and Crudelli allege that malaria fever arises from germs present in the soil and which float in the air over marshes; and that by treating with water the soil of a fever-haunted marsh of the Campagna the germs of this organism could be washed out; and that the water containing the organisms thus obtained, introduced into the circulation of a dog, produced ague more or less rapidly and more or less violent according to the numbers in which the organisms were present in the water.

This theory no doubt agrees with certain well-known facts.

In a tropical climate, if soil which has been long undisturbed, or the soil of marshy ground, be turned up, intermittent fever is almost certain to ensue.

In illustration of this, I recollect that at Hong Kong the troops were unhealthy, and a beautiful position on a peninsula exposed to the most favourable sea breezes was selected for a new encampment. The troops were encamped upon this spot for some time to test its healthiness, which was found to be all that could be desired. It was then resolved to build barracks—as soon as the foundations were dug, fever broke out.

As an instance of this nearer home I may mention that last winter at Cannes in the south of France, some extensive works adjacent to the town were begun, which required a large quantity of earth to be moved. The weather was exceptionally warm—an outbreak of fever occurred among the workmen, of whom fifteen died: this fever was attributed to the turning up of the soil.

If a strong solution of quinine be let fall in the water containing these organisms, they at once die: the efficacy of quinine as a preventive of this form of fever would therefore not be inconsistent with this theory.

Dr. Sternberg of the United States Army, who made experiments on the soil, water, and air of New Orleans, whilst he is unable to confirm the views of Professors Klebs and Crudelli, admits that there are many circumstances in favour of the hypothesis that the etiology of these fevers is connected, directly or indirectly, with the presence of these organisms or their germs in the air and water of malarial localities.

Sir Joseph Fayrer, whose large experience in India has given him exceptional knowledge of malarial fevers, in speaking of these researches of Klebs and Crudelli, says that the importance of such a discovery, if it were confirmed, could not be overrated; because if we take the world over, it is probable that some form of malaria is the most fruitful cause of disease; and that this theory offers an explanation which appears to correspond with what we know of the mode of operation of malaria:—First, that it occurs at certain heights, and that it is not necessarily connected with the presence of marshes, ponds, or rivers, nor with admixture of fresh or salt water, nor with the putrefaction of an organic substance. Second, that the production of malaria ceases when the air can no longer act on the soil; for the most pestilential marshes cease to be so when they are covered with water, or when the air is excluded by any interposing substance. Third, that a very moderate degree of humidity will produce malaria. Some malarial soils, innocuous during hot and dry weather, become dangerous after a shower, and so in the case of the upturning of new ground or the cutting down of jungle.

But he adds the following words of caution: "In our natural anxiety to find a particular origin for the poison or germ, we must not overlook the possibility that the results attributed to the so-called malaria may be due to disturbance of the system caused by gaseous emanations or by some other agencies, in a body predisposed to be so deranged by peculiarity of constitution, climatic or other influence, of the nature of which we are ignorant, though it is conceivable by analogy."

In the case of certain of the diseases mentioned, some very curious and valuable results have been obtained—results analogous to that of vaccination in the case of small-pox.

If the point of a needle be dipped in the blood of a fowl suffering from chicken cholera, and then placed in a vessel containing pure chicken soup, from which care has been taken to exclude all contamination by air-borne germs, and a suitable temperature be maintained, the bacterium or microbe (as M. Pasteur terms it), and cognate organisms which are found in the blood of the diseased fowl, multiply and render the liquid turbid by their presence. If a drop of the contents of this vessel be transferred to another portion of similar chicken soup, it, too, speedily becomes permeated with the organism. The process may be repeated a hundred times; and the result inoculated upon fowls, or given them in their food, will produce the same fatal effects. But if the infected chicken soup be allowed to remain for a few weeks or months, the malignant powers diminish: it becomes, as Pasteur terms it, "attenuated." A given quantity of infected chicken broth, even at the hundredth rapid cultivation, inoculated upon twenty chickens, would probably prove fatal to eighteen of them. If the same infusion were allowed to remain exposed to the air for a month, it would be so far attenuated that it would only prove fatal, say, to ten. Exposure for another month would render it still less virulent, so that it would only prove fatal to two or three; while after exposure for six or eight months it would not prove fatal in a single instance. In its most attenuated form the infusion gives rise only to trifling local symptoms, not at first recognizable as bearing any affinity to the deadly fowl cholera, and consisting of a small local slough. But the valuable fact discovered by M. Pasteur is that the attenuated infusion works upon the system a change protective against subsequent attacks of fowl cholera, exactly similar to that which has been remarked to be enjoyed by fowl that had recovered from the virulent form of the disease. Similar results are obtained in the case of anthrax or splenic fever in cattle.

The practice of mitigating the severity of attacks of disease by producing voluntarily a milder form of the disease is not new. Inoculation for small-pox has been practised in various ways from the most ancient times; because it was known that the occurrence of the disease caused some change in the blood or in the system of the person suffering from it which prevented the devolopment of the disease a second time, or mitigated the attack.

Jenner showed us that the milder disease of cow-pox caused a change in the system which produced a similar result.

With regard to more recent investigations, the most cautious observers are prepared to admit that in some diseases, such as anthrax, fowl cholera, and in some other diseases, it has been proved that there are certain organisms in the blood, or in the tissues, or in the morbid fluids in animals suffering from disease; that blood or fluids containing the organisms or their spores transmit the disease when inoculated; that when these organisms are absent or artificially separated, inoculation gives no such result; that the organisms can be cultivated outside the animal body, and after ten or fifteen generations the fluid which contains the cultivated organisms can reproduce the original disease when inoculated; and that the method of cultivation can modify or increase at will the virulence of the communicated disease.

There are some other diseases of the zymotic class besides those mentioned above, in which there is a probability that organisms may cause the disease; but experiments have not hitherto absolutely settled the question; and for the present our attitude must be one of reserve, much as we should wish it should prove all true.

When we consider the marvellous facility of reproduction of these various germs, shewn by these discoveries, we wonder how any higher form of life can exist subject to the possibility of invasion by such countless hosts of occult enemies.

But as we pursue the subject further, we find that the science of the prevention of disease, that is to say the science of hygiène, advances quite as rapidly as our knowledge of the causes of disease.

And even if the views of those who are prepared to accept the germ theory of disease to its fullest extent were shewn to be true, it seems also to be certain that if the invasion of these occult enemies present in the air is undertaken in insufficient force, or upon an animal in sufficiently robust health, they are refused a foothold and expelled; or if they have secured a lodgement in the tissues, they may be, so to speak, laid hold of and absorbed or digested by them. In corroboration of this view Professor Koch and others state that the micro-organisms of tubercular disease do not occur in the tissues of healthy bodies, and that when introduced into a living body their propagation and increase is greatly favoured by a low state of the general health.

The record of facts enunciated by the various scientific enquirers into the germ theory of disease affords an interesting contribution to the solution of etiological questions; but these enquirers have not yet given the sanitarian grounds of practical action: and for the present at least sanitary procedure is quite independent of them.

It has been long known, in many of those diseases which we term infectious or contagious, that by separating the individual attacked from the community, we may check the spread of the disease: and this practice has long prevailed.

The recent valuable and interesting report by your able medical officer of health, Dr. Armstrong, illustrates how the spread of scarlet fever and typhus have been checked in this city of Newcastle by the isolation of cases by removing them to hospitals: and how careful and systematic vaccination has secured immunity from the scourge of small-pox.

In some towns the local authorities have obtained power to compel the registration of all cases of infectious diseases within their jurisdiction. But it is very difficult effectively to isolate a patient in his own home; hence the further question arises as to what arrangements should be adopted for ensuring to the public the best means of isolation.

Special hospitals have been the panacea proposed; but a suspicion has recently arisen that if all cases of infectious diseases are concentrated in a special hospital in an inhabited district, this concentration of disease may have tended to intensify the disease and disseminate it in the neighbourhood.

Under the circumstances of the existing law we must mainly trust to voluntary effort to prevent the spread of infectious disease; and I may here quote the experience of a nurse of twenty years' experience in dealing with the most infectious and dangerous of these diseases, viz., scarlet fever. Her chief practice was the common one in respect to all cases of the various epidemics—to isolate the patient in a single room, the upper room if possible, and let no one else enter it; to so arrange as to keep the door and part of the window open in order to let a current of air pass through the room over the patient; to observe all the details of regulations as to the cleanliness of the patient and the articles of clothing and furniture, and the removal of excreta, &c.; and as to her own personal protection, never to drink out of the same vessel that had been used by the patient, and especially to wash from head to foot twice a day with tepid water, and to change her clothes each day: moreover she was careful never to serve in conditions of exhaustion with an empty stomach. With these precautions, she had never had a single case of the spread of the disease to a member of the family or anyone else during the twenty years; nor had she once contracted the disease herself.

Notwithstanding the numerous experiments and the great efforts which have been made in recent times to endeavour to trace out the origin of disease, the sanitarian has not yet been able to lift up the veil which conceals the causes connected with the occurrence of epidemic diseases.

These diseases come in recurring periods, sometimes at longer, sometimes at shorter intervals. Animals, as well as the human race, are similarly affected by these diseases of periodical recurrence; but why they prevail more in one year than in another, we are entirely ignorant. They appear to be subject to certain aerial or climatic conditions. Cholera affords an illustration of this.

There is a part of India, low-lying, water-logged, near the mouth of the Ganges, where cholera may be said to be endemic. In certain years, but why we know not, it spreads out of this district, and moves westward over the country: the people are sedentary and seldom leave home, but the cholera travels on. At last it arrives on the borders of the desert, where there are no people, and no intercourse, no alvine secretions, and no sewers, yet the statistician sitting in Calcutta can tell almost the day on which the epidemic influence will have crossed the desert. But it exercises discrimination in its attacks. It will visit one town or village, and leave many others in the vicinity untouched. Similarly it will attack one house and leave another. But it has been generally found that the attacked house or village held out a special invitation from its insanitary condition. The same houses or the same localities will be revisited in recurring epidemics, because the conditions remain the same; remove those conditions, and at the next recurrence the locality will escape.

At Malta it was found that the same localities and houses which yielded the majority of plague deaths there in 1813, yielded the majority of the deaths in the cholera epidemics of 1839 and 1867; and that in the intervals the same localities yielded the majority of cases of small-pox, fever and of an anthrax, a very special eruptive epidemic attended by carbuncles.

Hence, whilst we are unable either to account for the cause or to prevent the periodic recurrence of epidemic diseases, the sanitarian has learned that it is possible to mitigate the severity of the visit; and that whether these diseases arise from the occult causes to which I have alluded or from other causes, pure air and pure water afford almost absolute safeguards against most forms of zymotic disease.

Water has for many years been the subject of careful examination and analysis; indeed in the water supply for our large towns water examination may be said to be an ordinary branch of the service.

So long as the country was sparsely inhabited the question of the pollution of rivers was comparatively unimportant, because when sewage is discharged into running water, provided the primary dilution of the sewage with pure water be sufficient, the removal of the whole of the organic impurity will be effected after the run of a certain number of miles, the precise distance of travel being dependent on several conditions.

Perhaps the most beautiful instance of the self-cleansing power of a river is afforded by the Seine at Paris, where the river, which is black and foul when it leaves the town, becomes comparatively clear and full of water plants and fish at some ten or twelve miles lower down.

But the numerous centres of population in England, and the shortness of the rivers, leave them no time to exercise these self-cleansing processes; and some of the most important sanitary legislation in recent years has been devoted to the preservation of our rivers from pollution.

It is, however, shewn by Dr. Angus Smith's reports, under the Pollution of Rivers Acts, that either by the application of sewage to land, or by some of the methods of defecation which I will not further enter upon here, water from sewage may be so purified as to be placed in a flowing river without mischief.

And although there are many theories as to how far water which has once been contaminated by sewage may again after a time become fit to drink, I am disposed to think that there has never been a well-proved case of an outbreak of disease resulting from the use of drinking water, where the chemist would not unhesitatingly on analysis have condemned the water as an impure source; and it appears probable that, whatever may be the actual cause of certain diseases, *i.e.*, whether germs or chemical poisons, the materies morbi which finds its way into the river at the sewage outfall is destroyed, together with the organic impurity, after a certain length of flow.

Considering the density of population over the whole country, it is to be regretted that so much time has been lost in bringing these Acts into operation; and it is to be hoped that there will be no further delay in strictly enforcing the provisions of the Rivers Pollution Act.

With respect to air the question is somewhat different.

It is nearly fifty years ago since that able sanitarian, Mr. Chadwick, impressed on the community the evils which were caused by the impure condition of the air in our towns, owing to the retention of refuse round our houses.

In considering this question it is necessary to discriminate.

The gases which are the result of putrefaction are offensive to the smell, and some of them, as for instance sulphuretted hydrogen, are dangerous in that they may kill persons outright if they are present in undue proportions in the air; or if air containing smaller proportions of these gases be breathed for a long time the general tone of the individual inhaling them may be lowered, but they do not produce specific diseases. When, however, the putrefaction has gone on for some time, it may result in leading to the development of other conditions which may become the cause of disease, or death.

In connection with this question, M. Gustave Le Bon published recently in the *Comptes Rendus* some experiments relating to the properties and the influence of antiseptics on the volatile products of putrefaction.

He prepared a liquid made up of water and hashed meat. He placed a frog in an enclosure with some of the liquid. When putrefaction first set in, a very fetid odour was produced, and the liquid swarmed with bacteria, and he states that in this condition it is a very virulent poison if injected under the skin of an animal; but the frog merely breathing the effluvia, took no harm. After two months, the strong fetid odour had much diminished; the liquid had ceased to have virulent properties when injected under the skin, but the animal breathing its volatile products was rapidly killed by them. There is thus no parallelism between the virulent power of a substance in putrefaction, and the toxical power of the volatile compounds given off by it, indeed these powers seem to be in an inverse ratio. Moreover the older the putrefaction the weaker is the disinfectant power of any antiseptic over it.

These experiments are consistent with the observation that an offensive smell is often less injurious than the slighter fetid odour from an old drain, and that putrefying matter left for a long time in ashpits or manure heaps may be a source of danger: and it is also consistent with the observation that emanations from decomposing matter in the soil, such as refuse in old cesspools, or the stagnant deposit of sewage in badly constructed drains, may produce very dangerous results, although the odour is not strongly offensive; and they justify the established axiom that all refuse matter should be removed as rapidly as possible from the vicinity of dwellings.

There is no doubt that in the sewering of towns want of experience in the construction of the works has in some cases led to deposits in the sewers and to their failure to remove these dangerous gases, and that evil consequences have ensued; but it may be accepted as certain that in every case where the sewerage has been devised on sound principles, and where the works have been carried on under intelligent supervision, a largely reduced death-rate has invariably followed.

The records of your own city afford evidence of this fact.

The quinquennial period beginning in 1868 shewed a death-rate of 27·6, the quinquennial period ending in 1881 shewed a death-rate of 23; whilst the death-rate of 1881 was only 21·7.

At the recent Sanitary Congress at Vienna, some remarkable results of the effects of the sewerage of certain German towns were given, which are very striking.

Munich is the residence of one of the ablest sanitarians of Europe, viz., Dr. Pettenkofer. His admirable illustrations of the effect of the impurities which were accumulated in porous cesspits upon the air of the town and the death-rate of the population, form a text book of sanitary knowledge.

At Munich the enteric fever mortality per 1,000,000 of inhabitants for quinquennial periods was as under:—

1854 to 1859, when there were absolutely no regulations for keeping the soil clean	24·2
1860 to 1865, when reforms were begun by cementing the sides and bottoms of the porous cesspits ...	16·8
1866 to 1873, when there was partial sewerage ...	13·3
1876 to 1880, when the sewerage was complete ...	8·7

Similarly at Frankfort on the Main, the deaths from enteric fever per 10,000 were:—

1854 to 1859, when there was no sewerage	8·7
1875 to 1880, when the sewerage was complete ...	2·4

At Dantzig the figures present some more striking characteristics; the deaths from enteric fever per 100,000 living were as follows:—

1865 to 1869, when there was no sewerage and no proper water supply	108
1871 to 1875, after the introduction of water supply ...	90
1876 to 1880, after the introduction of sewerage ...	18

Hamburg has been drained by Mr. Lindley, and he has stated that in his plans he carefully followed the principles laid down by Mr. Chadwick.

In that town the deaths from enteric fever per 1000 of total deaths were from 1838 to 1844, before the commencement of the construction of any sewerage works ... ... 48·5

From 1871 to 1880, after the completion of the sewerage works ... ... 13·3

During the time that the works were in progress, viz., from 1872 to 1874, the mortality from enteric fever per 10,000 living was—

In the unsewered districts	40·0
In the districts for the most part sewered	32·0
And in the fully sewered districts	26·8

These results illustrate the effect of purifying the air of towns by the rapid abstraction of refuse matter, so as to prevent it from remaining and putrefying in and upon the ground.

But whilst the retention of refuse is probably the most fertile cause of mischief, there are other questions connected with the purity of air to which it is useful to direct our attention.

Dr. Angus Smith has given us very valuable information on this subject in his "*Contributions to the Beginnings of a Chemical Climatology.*" He shews that the air in the middle of the Atlantic ocean, on the sea shore, and on uncontaminated open spaces, commands the greatest amount of oxygen; that at the tops of hills the air contains more oxygen than at the bottom; and that places where putrefaction may be supposed to exist are subject to a diminution of oxygen. For instance, a diminution of oxygen and an increase of carbonic acid is decidedly apparent in crowded rooms, theatres, cowhouses, and stables. It is well known that oxygen over putrid substances is absorbed, whilst carbonic acid and other gases take its place; and hence all places near or in our houses which contain impurities diminish the oxygen of the air.

Let me explain to you what this diminution of oxygen means.

The average quantity of oxygen in pure air amounts to 21 parts out of 100.

In impure places, such for instance, as in a sleeping room where the windows had been shut all night, or in a lecture theatre after a lecture, or in a close stable, the oxygen has been found to be reduced to as little as 20 parts in 100. That is to say, a man breathing pure air obtains, and he requires, 2,164 grains of oxygen per hour. In bad air he would, if breathing at the same rate, get little over 2,000 grains of oxygen an hour, that is a loss of about eight per cent.; and this diminished quantity of oxygen is replaced with other, and in almost all cases, pernicious matters.

The oxygen is the hard-working, active substance that keeps up the fire, cooks the food, and purifies the blood; and, of course, as the proportion of oxygen in the air breathed diminishes, the lungs must exert themselves more to obtain the necessary quantity of oxygen for carrying on the functions of life. If the air is loaded with impurities, the lungs get clogged, and their power of absorbing the oxygen that is present in the air is diminished.

An individual breathing this impure air must therefore do less work; or, if he does the same amount of work, it is at a greater expense to his system.

In towns, the impurity of air arises chiefly from dust of refuse, mostly horse manure, as well as from smoke, and other products of combustion.

The influence of smoky town air on health is to some extent illustrated by the fact that the death rate of twenty-three manufacturing towns, selected chiefly for their smoky character, averaged 21·9 per 1,000 in 1880; whilst the rural districts in the counties of Wilts, Dorset, and Devon, excluding large towns, averaged 17·7 per 1,000; and the deaths from the principal zymotic diseases in the towns were more than double those in the rural districts.

Mr. Aitken, of Edinburgh, has made some very interesting experiments, showing that visible fog is due to particles of foreign matter floating in the air. He showed that the vapour of water injected into air, from which particles had been strained out, was not visible; whereas, as soon as foreign matter, such as dust, or smoke, or fumes, and especially fumes of sulphur, were introduced, the aqueous vapour condensed on the particles, and became visible as fog.

He showed that some kinds of dust have such an affinity for water, that they determine the condensation of vapour in unsaturated air, whilst other kinds of dust only form nuclei when the air is supersaturated; and that dry fogs are produced by those dust particles whose affinity for water vapour enables them to condense vapour in unsaturated air. Amongst this class of dust may be instanced chloride of sodium or salt, which largely pervades the atmosphere, and is probably derived from sea spray; also ammonia, which is present in town air, and may be largely due to the manure. In towns where the streets are paved with stone, asphalte, or wood, and even where the surface is of macadam composed of granite, the chief part of the mud and dust consists of horse manure, which continually gives off the fumes of ammonia; and this substance when mixed with fumes of sulphur has a greater power of condensing aqueous vapour than the products of combustion of pure coal, and gives rise to a very fine textured dry fog.

The conclusions which may be drawn from these experiments are: 1st, That when water vapour condenses in the atmosphere, it always does so on some solid nucleus; 2nd, That the dust particles in the air form the nuclei on which it condenses; 3rd, If there was no dust in the air there would be no fogs, no clouds, no mists, and probably no rain; but when the air got into the condition in which rain falls—that is, burdened with supersaturated vapour—it would convert everything on the surface of the earth into a condenser, on which it would deposit itself. Every blade of grass, and every branch of tree would drip with moisture deposited by the passing air; our dresses would become wet and dripping, and umbrellas useless; but our miseries would not end here. The inside of our houses would become wet; the walls and every object in the room would run with moisture.

Hence we have in this fine dust a most beautiful illustration of how the little things in this world work great and useful effects in virtue of their numbers.

This dust pervades the air everywhere. The haze in the air on a summer's day is caused by dust, which is probably largely composed of the pollen of flowers. This dust appears to occupy the lower strata of air, for in the valleys on the South or Italian side of the Alps a blue haze mellows the view; but this is passed through after a little hill-climbing, and the atmosphere becomes clearer.

The theory is not inconsistent with the formation of the loftiest clouds, because dust does not only pervade the lower region of the atmosphere.

Mr. Langley was making observations last autumn on the spectrum of the sun on Mount Whitney, which is within some 300 miles north of the Mexican frontier, and about 200 miles from the Pacific Ocean. When at a height of 13,000 feet above the sea, he observed dust in the atmosphere between him and the sun. He computed that this dust was at a height of from 1,000 to 1,500 feet above the elevation at which he was placed; that is to say, at a total height of from 14,000 to 15,000 feet above the sea. It has been suggested that this dust might have been carried by the prevailing winds from the plains composed of loess in China.

There is, however, another source whence dust in the air at higher altitudes may be derived; for recent investigations shew that appreciable quantities of meteoric dust are being constantly brought into our atmosphere from interplanetary space.

In our towns the dust is more plentiful, but there also it diminishes with elevation.

The clumsy and barbarous method which we adopt for burning coal in this country adds to the dust the fumes which necessarily result from combustion, as well as a quantity of soot and tarry matter from the imperfect combustion of coal.

Mr. Chandler Roberts, who made experiments on the question of the amount of soot from different forms of grates for the

Smoke Abatement Society, found the quantity of soot to vary from about one per cent. in most furnaces, to as much, in some instances, as three per cent. of the fuel consumed in domestic fire places; that is to say, the imperfect combustion causes from one to three cwt. of soot for every five tons of coal consumed.

This soot assists in forming the black canopy which it is fashion in England to consider the proper attribute of a large town.

Dr. Frankland and Dr. Russell have shewn that the tarry matter which arises from the combustion of coal, coats over the water resulting from the aqueous vapour thus condensed upon the particles of dust, and considerably delays their re-evaporation; consequently whilst the atmosphere of large towns is more favourable to the development of fog, the fogs prevailing over large towns are more persistent in their character than in the open country. Moreover, the fumes from combustion contain substances, and especially sulphur, which appear to be more favourable to the formation of fogs than any other form of dust; and, therefore, even if whilst continuing to burn coal in our towns we get rid of smoke, we should still have products of combustion, which would favour the occurrence of fogs; but they would be fogs of lighter colour and less persistency than our ordinary London smoke fog.

The conclusions at which Mr. Aitken has arrived from his experiments are well illustrated by a fact of every day experience. A heavy fall of rain washes the particles of dust out of the air, and after rain the fog is often removed, and the air of a town is much clearer.

But in addition to the chemical and inorganic constituents of air which have been generally taken as a measure of its purity, recent researches have divulged to us the character of some of its organic impurities.

Dr. Tyndall has shewn us, by passing a ray of light through a space otherwise dark, that all air is more or less filled with dust; that this dust is destroyed by incineration, and that it is therefore chiefly organic; and his experiments, made with infusions previously freed from all possibility of containing germs in the infusion, or as he terms it sterilized, demonstrated that this dust contains germs which are always ready to spring into life when a congenial medium for their development is at hand.

He shows that if the air of a room be left absolutely undisturbed for some time, this dust is more rapidly deposited than in moving air. Thus in a sheltered and quiescent position in a room, flasks filled with various infusions developed organisms more rapidly than those placed in the more open parts of the room.

Dr. Tyndall has also shewn by similar experiments that these sterilized infusions did not develop organisms when exposed to the clear mountain air on the Bel Alp in Switzerland, whilst the air of a hay-loft near the glacier developed organisms in 90 per cent. of the flasks containing sterilized infusions.

M. Marie Davy, of the Montsouris Observatory of Paris, tells us that the air near to the Hotel Dieu in the centre of Paris and near an opening to a sewer, is more prolific in causing the development of bacteria and similar organisms, in prepared sterilized infusions, than air in the more open space near the Montsouris Observatory; and that the latter is more prolific than air on the plateau of Gravelle near Paris.

M. Davy also tells us that the air in rainy weather is less prolific in producing bacteria; that it becomes more prolific during the drying up of the rain; but becomes less prolific again in drought and in sunshine. Similarly, the numbers of bacteria are very small in winter; they increase during the spring; attain their maximum in autumn; and then decrease with the rain and cold weather on the approach of winter. The cold of a Parisian winter is inimical to them, and so is dry hot weather, and especially sunshine.

It is not alleged that those various organisms are all productive of disease or injurious to the higher forms of life. Some are no doubt productive of what we term putrefaction; others may be productive of disease; but some may possibly afford nourishment.

It is, however, noteworthy that those observations which shew the presence and absence of organisms in certain localities and in certain conditions of the atmosphere, seem to present coincidences with other observations on the prevalence of certain diseases, which at least make it desirable that the enquiries should be further pursued.

For instance, in the Punjab the mortality from fever deaths in each of three consecutive years, 1872–73–74, when food was cheap and when there was no extraordinary occurrence to affect the ordinary relations between fever and rainfall, the fever deaths only began to rise after the rainfall had attained its maximum and had begun to decrease, and the deaths from fever attained their maximum soon after the rainy season came to an end, during the drying up of the ground, after which they decreased.

In Bombay the registered fever deaths on a mean of fourteen years shows a minimum of fever deaths during the hot, bright, and dry season.

It is also noteworthy, more especially in hot climates, that those rooms of a house into which sunshine can penetrate are healthy, whereas rooms where no sunshine can penetrate are unhealthy.

In our present knowledge, it would be premature to draw any conclusions from these various researches; but they open out an interesting field of enquiry which it is not presumptuous to think may possibly have some bearing on the prevalence of disease.

But whatever may be the influence which such organisms or germs exert on the production of zymotic diseases, the sanitarian has attained to the absolute certainty that the number of persons who are attacked by this class of diseases can be increased or diminished in proportion to the defects or the excellence of the hygienic conditions under which they are living.

I have already mentioned to you the effects of sewerage on the mortality of towns.

On the general effect of sanitary conditions upon health, the experience of the Indian army is very striking.

Periodic fevers occur everywhere in India, and there arise extra vicissitudes of temperature and endemic causes of dangerous disease. Yet there, even under these circumstances, sanitary work, by removing preventible causes of disease, has reduced the death-rate of the European Army in India from 60 per 1,000 to 16 per 1,000, and is gradually diminishing the death-rate of the civil population.

Perhaps one of the most conclusive examples of the effect of sanitary observances is that furnished by fairs and religious festivals in India. These assemblies bring together many thousands of persons, sometimes even as many as 100,000 persons, together with numerous horses and cattle. They form a huge encampment lasting for many days, sometimes for weeks. A very few years ago there was no care taken to prevent the fouling of wells and water-courses, or to regulate the disposal of the refuse which was scattered all over the surface of the ground where this multitude encamped. These fairs and festivals were therefore almost invariably foci for the spread of cholera and other diseases. Now this is changed. Stringent regulations preserve the wells and water-courses from pollution, and compel the people to deposit all refuse in prepared places. All the rest of the ground in the vicinity of the encampment is kept scrupulously clean. Since this has been done, many festivals and fairs have been held in districts where cholera has been prevalent, but yet, owing to these stringent regulations, no cases of cholera have occurred amongst the persons attending the fairs and festivals.

We may find, perhaps, more striking results from the influence of sanitary work in India or in a tropical climate than elsewhere; but still we are surrounded by numerous examples of the effect of sanitary work at home.

In the Foot Guards in London, the deaths from tubercular disease used to be 10 per 1,000—in fact equal in amount to the total deaths which now occur in the Army in peace time.

The improvements in the hygienic conditions under which soldiers live, which were introduced into the Army in consequence of the recommendation of the Royal Commission on the Sanitary State of the Army and the Barrack and Hospital Commission, have reduced this death-rate from tubercular disease to about 3 per 1,000. This is one of the diseases which it is now alleged can be or is propagated by germs; and it is to this point that I desire especially to call attention, viz., that whatever be the manner in which these zymotic diseases are propagated, the death-rate and consequent sickness may be diminished or increased according to the sanitary conditions in which a population lives.

In this city of Newcastle the number of deaths per 1,000 was 25·4 in 1870, 26·1 in 1875, 23·5 in 1879, 22·8 in 1880, and in 1881 it was 21·8 per 1,000.

We are accustomed to speak of a death-rate of so many per 1,000 in a great city—we ought at the same time to recollect that this death-rate is made up of many details. For instance, in 1875, the death-rate for the entire City of Newcastle was 26·1 per 1,000; but there was a group of buildings, called the old Pandon group, since pulled down, in which the death-rate was 40 per 1,000, and in parts of that group of buildings the death-rate amounted to 54 per 1,000.

It is very difficult to obtain the death-rate of a limited area; but I will give you some instances from districts in London where the figures have been stated in the evidence given to the Select Committee of the House of Commons on the Artizans' and Labourers' Dwellings Act.

These districts were condemned by the medical officers chiefly by reason of the closeness, narrowness, and bad arrangement of streets, courts, and alleys.

In Limehouse, whilst the average death-rate of the population of the district was 23·9, the death-rate of a special part of the district was 50 per 1,000. The population on this part of the district was 514 per acre.

In Whitechapel and Aldgate there was a district of six acres which had 625 persons per acre, the death-rate in that part being 50 per cent. above the death-rate of the district. In some parts of the area there were 1,423 persons per acre.

In St. Giles, whilst the death-rate of the Northern district was 21·82 per 1,000, that of the Southern portion was 33·16 per

1,000. In parts of this district the area was covered with very narrow courts and alleys, with badly ventilated and dilapidated houses, many of them without back yards, and the rears almost touching each other. In this area the death-rate was 40 per 1,000, as against 25 per 1,000 for the whole district, and 17 per 1,000 for St. George's, Bloomsbury, which is close by.

Parts of these districts have been cleared under the Artizans' and Labourers' Dwellings Act, and new dwellings have been constructed by the Peabody Trustees and by various Companies formed in London for providing improved dwellings.

These improved dwellings are built in several stories one above the other. They afford accommodation to a population per acre as dense as, and in most cases even denser than, that afforded by the buildings which they replaced.

Within limits it is not the density of population which regulates the health. But if a dense population is spread over the surface, or close to the surface of the ground, by which means all movement of air is prevented, and if there are numerous corners in which refuse is accumulated, it will be difficult to prevent disease.

Dr. Angus Smith's experiments shew that whilst there is less oxygen and more carbonic acid in the eastern and in the more crowded parts of London, yet, that in open spaces the amount of oxygen rises and the carbonic acid diminishes very considerably; and that we are exposed to distinct currents of good air in the worst, and equally to currents of bad air in the best atmosphere, in towns like Manchester.

Dr. Tyndall shewed that where there is quiescence in the air the tendency of his sterilized infusions to produce organisms was increased.

The conclusion from all these experiments is to show the importance of laying out the general plan of dwellings in a town, so that currents of air shall be able to flow on all sides with as little impediment as possible, by which means the air will be continually liable to renewal by purer air.

The dwellings which have been constructed in the place of the very defective dwellings condemned by the Medical Officers of Health in various parts of London, specially illustrate the importance of this question of the circulation of air.

These dwellings replace those in which the normal mortality was as much as 33, 44, and 50 per 1,000.

But these improved dwellings provide ample space all round the blocks of building, so that air can flow round and through them in every direction, and so that there are no narrow courts and hidden corners for the accumulation of refuse. In some cases these dwellings accommodate above 1,100 persons per acre.

The mortality in the new dwellings is as low as 13 per 1,000 in some, and does not rise above 20 per 1,000 in any of them, and upon an average of years it may be taken at from 14 to 16 per 1,000.

It is to this point that I specially desire to draw your attention, viz.: that these facts prove the possibility of bringing down the death-rate of the class of population which inhabits this sort of accommodation to rates varying from 15 to 16 per 1,000. I say of the class of population because habits and mode of life have an important influence on health and on longevity.

Mr. Chadwick and Dr. Richardson obtained some statistics for Westminster, for the use of a Committee of the Society of Arts, which indicate the very different conditions of health to which the different classes of population are subject (Appendix A, p. 55). The divisions they adopted were as follows:—

First, the class of professional persons, or of those classed as gentry; secondly, the salaried classes, clerks and mechanics, and wholesale dealers; thirdly, the general classes of retail traders or shopkeepers; fourthly, the wage classes, artizans and labourers; and fifthly, domestic servants.

Each of these classes, it will be seen, represents very distinct sanitary conditions as to streets, houses, room space, overcrowding, and filth.

It appeared from these statistics that out of 100 deaths of the first class, or gentry, six were those of children in their first year, and nine of children within their fifth year; whilst out of 100 deaths of the wage classes 22 are those of children in their first year, and 39 within their fifth year.

If we take the average duration of life of all who have died of the first class, men, women, and children, we find that they have had an average of 55 years and 8 months of life; whilst of the wage classes they have had a mean of only 28 years and 9 months.

And if we take the average duration of life of those who have escaped the earlier ravages of death up to 20 years of age, the males who have died of the first class have had 61 years of life, whilst of the wage class the males have had only 47 years and 7 months. Moreover, of the first class in Westminster, the proportion who have attained to old age, and died of natural causes, is 3·27 per cent., but of the wage classes only a fraction, or $\frac{2}{3}$ per cent. did so.

I have obtained similar returns for this city (Appendix B, p. 56).

It was considered desirable, for the purpose of this return, to divide the population into the following five classes—

First, Gentry and Professional men; Second, Tradesmen and Shopkeepers; Third, Shipwrights, Chain and Anchor Smiths, Iron Forge Labourers, &c.; Fourth, Seamen, Watermen, Fishermen, &c.; Fifth, Other Wage Classes and Artizans; and each of these classes represents distinct sanitary conditions and habits of life.

The healthiest class is that of the seamen, watermen, and fishermen. The mean age at death of all who died of that class, men, women, and children, is 37 years; as compared with 35 years for gentry and professional men; whilst the mean age of shipwrights, chain and anchor makers, and iron forge labourers, is only 22 years.

A further examination of this table shews that this great difference in the average length of life arises from the great excess of deaths in childhood of the wage classes above those of either the seamen and watermen class or the gentry and professional class; the proportion per cent. of deaths of children under five years of age to total deaths is in the class of shipwrights and iron forge labourers, &c., 47·96, in the wages classes 41·52, in the class of gentry and professional men 33·93, and in the fisherman class 26·77: and the mean duration of life of the males who had survived the period of youth, that is to say, of those above 20 years of age, was for the gentry class 53 years, for the tradesmen 54 years, for the seamen and fishermen class 52 years, for the shipwright class 46½ years, and for the other wage classes 49·9 years.

I have also obtained for comparison returns from the borough of Dover (Appendix C, p. 57), which is a sea-port town with what may be called a favourable mortality, viz., an average death-rate of 16·7 per 1,000.

In that town the mean duration of life in the wage class, artizans, &c., of all who died, is 33½ years; and of those who died over 20 it is 55 years; and the proportion of deaths of children under 5 years of age is 36 per cent. of the total deaths, instead of the 48 per cent. of deaths in the shipwright class in Newcastle.

As a contrast to the returns for the City of Newcastle, I have obtained information respecting certain rural parishes in Northumberland. These parishes are comprised in the registration districts of Bellingham and Rothbury, together with the sub-districts of Islandshire and Norhamshire, in the parish of Chatton (Appendix D, p. 58).

In this return the population is divided into the following classes:—First, Gentry, Professional men, &c.; Secondly, Farmers; Thirdly, Tradesmen, Shopkeepers, &c.; Fourthly, Wage Classes, Artizans, &c.; Fifthly, Agricultural Labourers.

Although the average mortality of the districts is 15·3 per 1,000, as compared with 21·8 per 1,000 for Newcastle, the proportion of zymotic diseases shews that these districts cannot be considered to be in very favourable conditions of health.

A comparison of these returns affords much food for reflection, and makes us regret that the returns of the Registrar-General do not afford us more information upon the relative health of the different classes of the community.

The mean duration of life of all who died was 42·3 years as compared with 29·4 years in Newcastle, and of those who had survived the period of youth and reached the age of 20, the mean age at death of the males was 60·9 years, as compared with 51·9 years in Newcastle. For the Wage and Artizans class in the rural parishes the mean age at death of all who died was 35·4 years, and for the Agricultural Labourers, &c., 42·2 years, as compared with 22·3 years for the Shipwrights, &c., class, and 27·0 years for the other wage classes in Newcastle; whilst for the males who had survived the period of youth and attained the age of 20, in the rural districts the mean age at death was 56·0 for the Wage and Artizans' class, and 63·7 for the Agricultural labourers, as compared with 46·6 for the Shipwrights, &c., class, and 49·9 for the other wage classes in Newcastle.

I may also instance the rural district of Uttoxeter, where the mean age at death of all who died of the wage class, including agricultural labourers, was 39 years, whilst that of the agricultural labourers alone was 40 years; and the mean age of those who died over 20 was 62 years; yet this is not a particularly healthy rural district, since the proportion of deaths from epidemic disease to the total deaths was 26·5.

Thus the parallel classes in the rural districts enjoy at least 10 years more life than those in Newcastle, and yet it will be observed that the proportion of deaths from the principal zymotic diseases (excluding diarrhœa) in the rural districts is less favourable than in Newcastle.

In contrast with these rural districts, and as an illustration of the effect of insanitary surroundings on health, it may be mentioned that on the experience of a decade in a district in Ireland, situated in Connaught, where there was a large proportion of mud hovels having only one room, the mean age of all who died was only 26·8 years as compared with 42·3 years in the rural districts of Northumberland; and the proportion of deaths from epidemic diseases to total deaths was 47·8 per cent. The occupiers were chiefly peasant proprietors.*

* It is interesting to mention, in connection with this question of the relative death-rate, that the wages of the agricultural labourers in the rural parishes of Northumberland may be assumed to be for the men from 18s. to 20s. a week; the wife or daughter may earn 7s. 6d. a week, and for about

A low standard for the mean duration of life in the wage class is not a necessity. It is controllable by the surroundings in which they live; and the fact of how largely the death-rate is influenced by these surroundings is evidenced by the condition of health in Improved Industrial Dwellings.

Mr. Gatliff shews that the death-rate over a series of years in the buildings of the Metropolitan Association for Improving the Dwellings of the Labouring Classes, varied from 14 per 1,000 to 17 per 1,000; and in the buildings of the Improved Industrial Dwellings Company, under Sir Sydney Waterlow, the mortality during a period of over 16 years has been 16·2 per 1,000.

Similar results are obtained in the Improved Industrial Dwellings in Newcastle. The able manager of this property, Mr. Price, will, I believe, furnish a full account of these dwellings to the meeting. I would therefore only mention that Mr. Price informs me that in these dwellings are accommodated 108 families or 450 persons. The death-rate for the year ending June 30, 1882, has only been at the rate of 12 in the 1,000, whilst the rest of the city of Newcastle shews an average of 21·6. This result must be considered the more satisfactory when it is remembered that these buildings are tenanted by the lowest wage-earning class. Out of the 108 tenants there are only two who earn 30s. per week, the majority being labourers averaging 21s. per week, and several less than that sum.

The effect of the sanitary conditions under which people live is further well illustrated by comparing the condition of health enjoyed by those who may be assumed to have been removed from unhealthy influences in their ordinary life, and placed in healthy surroundings.

I have obtained, through the courtesy of Mr. Hardcastle, a return from the Prison at Newcastle-upon-Tyne, shewing the health condition of prisoners who entered the prison without any disease.

From this it appears that during the five years ended June, 1882, nearly 20,000 prisoners passed through the prison, and that during the whole of that time there was no death from zymotic disease in the prison, although during that period there were epidemics of Scarlatina, Typhus, and Small-pox in the

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three weeks in harvest time probably 10s. 6d. per week extra, say from £46 to £65 a year. Mr. Murphy, Professor of Agriculture in Ireland, in a work on a Model Farm, estimates that the outcome in wages of the work of a peasant proprietor and his wife and child on his farm, of eight acres, is only £25 a year. Also Mr. Jenkins, the Secretary to the Royal Agricultural Society, states that he examined the outcome of the peasants' earnings in Belgium and France, and that he could not make out that the tenant's profit on ten acres came to more than £30 a year.

Borough. Moreover, during three of the five years, there were no deaths at all of prisoners admitted without previous disease; whilst in 1879 the deaths in this class amounted to ·027 per 1,000, and in 1881 to ·025 per 1,000.

After commenting upon the good sanitary state of the Prison, Mr. Hardcastle makes the following suggestive remark:—"There is not the slightest doubt that if my private patients lived under similar conditions they would enjoy better health."

In considering how far it can be hoped that the death-rate of the wage classes can be permanently reduced to that of the more fortunate classes, there have to be considered the questions of the occupation of the members of the classes when out of their homes.

If we take the professional and merchant class who attend at their offices during the day time, we may be sure that, as a rule, they are placed in unhealthy surroundings during that time, and in many cases have to breathe, during their hours of work, as bad an atmosphere as that in which the wage classes work.

The great mortality of the tradesmen class shewn in Mr. Chadwick's return for Westminster was explained by him to arise from the fact that the best rooms of the houses in which they live are let for lodgings, and that they often live in the basements or back premises, which are frequently unhealthy. Whilst we may anticipate great improvements in the health of the wage classes by the construction of improved dwellings, these must be supplemented by healthy arrangements in the pursuit of their daily avocations. Indeed in many cases education is required to teach workmen to attend to precautions devised for their health; they often look upon ill health as a matter of course.

The deaths of children, who are the most influenced by the conditions of air, and the least by occupations and by migration, especially those under one year, are regarded foremost exponents of sanitary conditions.

The tables in Appendix E and F (p. 59), shew the annual rate of mortality per 1,000 of population; the mean age at death; and the expectation of life, at several ages, for the City of Newcastle for 1881, and for Dover in 1880.

In the City of Newcastle, the annual rate of mortality per 1,000 for all ages was for males 23·15, and for females 20·13, whilst for children under five years it was 66·19 for males and 54·77 for females. In Dover, whilst the mortality per 1,000 of all classes was for males 18·13 and for females 15·37, it was for children under five years 62·61 for males and 44·47 for females.

The very marked difference, shewn in the returns I have spoken of, in the mean duration of life of the wage classes as compared with the well to do class, is no doubt largely attributable to the deaths of the young.

The large death-rate of children and of young persons arises from a variety of causes which it may be difficult entirely to remove; it must, to some extent, be dependent on the health of the parents, but it is often the result of improper food.

An instance, from your own town, illustrates this point.

The Reverend Mr. Lintott, who manages the Northern Counties Orphan Institution, informs me that the children there have been singularly free, during the eighteen years the Institution has been in existence, from children's disorders.

Each child has a pint of new milk every day. Some years ago milk was very dear, and for three months the children received half the quantity, weak tea for the evening meal being substituted. During the latter part of that time, the number of the children who were unwell, from various causes, was greater than it had been for years; the milk was restored, and the Orphanage became as free as ever from the usual disorders of children.

But the condition of the surroundings, in which children are placed, also materially influences their death-rate. If the choice lay between giving young children plenty of food whilst they were exposed to bad air, or giving them little food whilst they were placed in pure air, it would be preferable for their health to select the latter alternative.

Some evidence of the effect of pure air on children is afforded by comparing the table of mortuary statistics of Newcastle with that of the rural parishes of Northumberland. The proportion per cent. of deaths of children under five years to total deaths in the class of tradesmen and shopkeepers in Newcastle is 37, as against 20·48 for the same class in the rural parishes; whilst for the shipwrights, smiths, and forge labourers class it is 47·96; and for the other wage and artizans class it is 41·52 in Newcastle, as compared with 28·72 for the wage and artizans class, and 22·59 for agricultural labourers in the rural parishes. On the other hand for the seamen and fishermen class in Newcastle, the proportion is 26·77. It would be interesting to trace out the reason why the proportion of children's deaths in this class differs so materially from that of the other wage classes in Newcastle, and so nearly coincides with that of the wage classes and agricultural labourers in the rural district.

In further evidence of the effect of the surroundings on the health of children, it may be mentioned that whilst the mortality of children under 10 in the Metropolis generally was 47·66 per 1,000, that of children in the Improved Dwellings was 24·04 per 1,000, or less than one half.

Moreover, in the buildings of the Improved Industrial Dwellings Company, during a period of 16 years, the death-rate per 1,000 of persons over one year of age was only 10·35 in the Company's Dwellings, whilst it was 17 in the Metropolis.

The death-rate of infants under one year of age was even more favourable; for although the birth-rate was 5 in a 1,000 more in the Company's Dwellings than in the Metropolis generally, the death-rate of infants was only 1·7 higher in the Improved Dwellings than in the Metropolis, thus shewing that the conditions of occupancy in these dwellings are as favourable for infants as they are for persons of riper years.

The other Companies who have built improved dwellings can shew equally favourable results.

We have done much for the health of young people by the Factory Acts in regulating their labour; and we have made stringent rules to compel their attendance at School; but in these latter regulations it is to be feared that the health of the children has been too little considered.

Mr. Chadwick and Dr. Richardson have long pressed upon the consideration of the public the defects of the elementary school system, first as to the insanitary conditions of the rooms in which most of the school work is performed, and secondly as to the advantages which have been found to result from making physical training a portion of ordinary school work.

Dr. Richardson shews that the long hours spent in school do not produce results commensurate with their length. That is to say, he shews that in those schools where half the time is allotted to physical training, the children learn quite as much as in schools where the whole time is devoted to study; that the children are brighter, and that they are eventually turned out of the school better qualified to take up the avocations of daily life.

On the other hand, the condition of the children is an important factor in the ventilation of a school room. With children who are not washed all over daily, the skin and the clothes assist in producing a foul atmosphere; and the rooms crowded with children in that condition require special means of ventilation. Unless this is provided the atmosphere is injurious. But as a rule the children are not thoroughly washed every day, nor are exceptional means of ventilation provided.

From some recent statistics it appears that the death-rate of elementary school teachers amounts to as much as 20 per 1,000, which is more than double that of soldiers on home service, and about four times that of the police or of sailors, in which forces, apart from deaths from accident or violence incurred in their profession, it amounts to about 5 per 1,000. It is even from five, six, to seven times greater than that of those criminals who are imprisoned who have no specific disease, amongst whom, when they enter a well-conditioned prison, the death-rate does not exceed 3 per 1,000. The sickness will be proportioned to the death-rates; and there can be no question but that the high death-rate is largely due to the unhealthy atmosphere in which their work is performed.

Dr. Carpenter says in his work on "Human Physiology," that the "purity of the atmosphere habitually respired is essential to the maintenance of that power of resisting disease which, even more than the ordinary state of health, is a measure of the real vigour of the system. For, owing to the extraordinary capability which the human body possesses of accommodating itself to circumstances, it not unfrequently happens that individuals continue for years to breathe a most unwholesome atmosphere without apparently suffering from it; and thus when they at last succumb to some epidemic disease their death is attributed solely to the latter, the previous preparation of their bodies for the reception and development of the zymotic poison being altogether overlooked."

It is not so many years ago that the death-rate of the Army at home nearly equalled that now prevailing among the elementary school teachers. The large army death-rate was shewn to arise from defective ventilation and want of other sanitary arrangements. These were remedied, and the Army death-rate was reduced to from 8 to 11 per 1,000; and there can be no doubt that if the same care were bestowed upon the purity of air in and around our schoolrooms as is bestowed upon our barrack rooms and prison cells, the health of school teachers and of the children would be materially benefited.

The following extract from a paper by Mr. Chadwick sums up this experience:—

"In one orphan institution the progress made by the application of sanitary factors was thus denoted. The death-rate amongst the children was twelve in a thousand. The impurity of the air was removed by better drainage, and the death-rate reduced to eight in a thousand. A further advance was made by regular head-to-foot ablutions of the children with tepid water, and a complete skin cleanliness maintained, when the death-rate was reduced to four in a thousand. In the district half-time schools near London, where the sanitation is the best advanced, they receive children of the lowest condition and type, and may be said to be children's hospitals; but of those who come in without any developed disease, the death-rates from disease of spontaneous origin do not exceed three in a thousand, or one-third of those of children in the Board or common schools. I deduce from experience that skin cleanliness and clothes cleanliness is a factor of prevention of the common death-rates amongst dirty children in crowds or in schools by one-third."

Mr. Chadwick further dwells on the economy of cleanliness. He states that it has been ascertained that pigs that are washed put on one-fourth more flesh from the same quantity of food than do pigs that are unwashed. The food that would be required for four children that are unwashed would serve for five children that are washed. A general whose army was hemmed in and put upon short rations encouraged his men to bathe daily; he said that by that means he kept his men in as good condition and force as another division of the army that was on full rations but unwashed.

I am informed by colliery proprietors that horses in a colliery which are well groomed do more work and look better than badly groomed horses with an equal amount of food. And there is a German proverb which may be translated: "Well washed is half the feeding."

My object in presenting to you these facts is to show you that you must not be satisfied with an average death-rate in your towns of 21·8 per 1,000, but that you should investigate the death-rate in each part of your town, and in each class of your population at several ages, and ascertain where it is in excess and what are the causes of the excess, and then do your utmost to remove those causes.

For the death-rate is an indication of the degree of wasted force in the country.

Let us consider for a moment the losses to the country which are evidenced by a high death-rate.

Take a professional man who has accumulated a large amount of knowledge, and what is better, of experience; or take an artizan who is a skilful craftsman. They die in the prime of life when they are most fitted to use these qualities; the knowledge, experience, and skill, which have required many years and much labour and expense to accumulate, all go with them, before the crop of usefulness, in the cultivation of which so much has been expended, has ripened and been gathered.

But there is also to be considered the loss by sickness.

The death-rate affords to some extent an index of the disease rate in the community. It is, however, very difficult to ascertain with any degree of accuracy the disease rate of a community, as compared with the death-rate.

If we take the Army as a criterion, it would seem that there are more than 100 men admitted to hospital to one death, whilst the number constantly sick averages from four to six times the number of deaths. No doubt in the Army many an ailment has to be treated in hospital which in ordinary life would allow the sufferer still to pursue his avocations.

The sickness of the population is not registered, and it is very difficult to obtain any data respecting it. It has been generally stated that there are on an average 20 cases of sickness to one of death, of which 4 cases out of 5 are those of children. I find, however, from a return of an unsanitary district in St. George's-in-the-East, that with a death-rate of 31 per 1,000, the sickness rate was 270 per 1,000, or 9 cases of sickness to one death. But in the worst parts of the same district the sickness rate amounted to 620 per 1,000, which gives 20 cases of sickness to one death.

Mr. Neison, who has recently examined the records of the Ancient Order of Foresters, shews that at 35 years of age there are on an average 22 cases of sickness to one death, and that is in a body of men which it must be borne in mind are selected men so far as health is concerned. From the same record we find that at 20 years of age the loss of time from sickness amounts to 1·5 per cent. of the whole time; and at 40 years of age it amounts to 2·6 per cent.

The value of a single premium paid at 20 years old, (calculated on the 3 per cent. tables) to insure £1 a week during sickness, for the whole life, is £40.

I sought, but failed to obtain, definite statistics on this subject from some of those who are working amongst the poor, both in the east and west end of London.

An east-end clergyman remarked that "the poor go on *living* wonderfully in wretched places, but that they have so much *ill-health.* They are perpetually on the trudge to the Hospitals with their bad chests and bad legs, and get patched up again and again, and live on."

Our London Hospitals and Dispensaries cost, according to Mr. Burdett's statistics, nearly £600,000 annually to administer. The average number of out-patients treated at the various institutions in a year is about 1,000,000—that is to say, more than one out of every four inhabitants of the Metropolis becomes an out-patient in the course of the year.

This expenditure is incurred mainly for the purpose of patching up the wretched poor, who have been injured by bad drainage, want of ventilation, darkness, &c. Though drink may be one of the immediate causes of many hospital cases, yet the tendency to drink is created and fostered by the wretched dwellings of the very poor. But besides the time lost by the sickness itself, there is the large amount of time wasted by the poor in going to and waiting at hospitals, which would be spent by healthy poor in labour.

There is, moreover, the great amount of lassitude and idleness in the low-class poor, which Dr. Richardson traces to want of ventilation, in their own and former generations.

I think we may safely assume that if you can, by preventive arrangements, bring down the death-rate of the wage class to the standard afforded in good sanitation, you would reduce the sickness rate in a similar proportion at least. By means of this item alone the wage earning power of the industrious classes would be enlarged by some millions of pounds, and their comfort correspondingly increased.

You would effect, in addition to the savings under this head, certain other distinct economies. For instance, it is certain that the need for much of the accommodation in our prisons, reformatories, and workhouses arises from evils incident to unhealthy circumstances and crowded dwellings.

We shall probably be led to appreciate more fully the advantages of good sanitation if we can arrive at putting a money value upon some of the more direct results of sanitary improvements.

In the first place the community derives a direct advantage from adopting such a system for the removal of refuse as will enable it to be applied directly to improving the cultivation of land. For whilst on the one hand the rapid removal of refuse from the neighbourhood of dwellings by the efficient sewering of towns results in improved health, the application of sewage to land by the irrigation of growing crops affords both a means of fertilizing the land, and of cleansing the fluid, so as to place it in a fit condition to pass into the streams.

My friend Mr. Chadwick asserts that where the sewage is undiluted with rain-water, and where it is utilized at once, and carefully applied under favourable conditions, an acre of land ought to absorb the sewage of 100 persons, and that the crops on this area should feed five cows; or, if put in another way, that the produce of ordinary cultivation being represented by 1, and market garden produce by $3\frac{1}{2}$, the produce of sewage cultivation should be represented by 5.

I have obtained some recent facts on the direct application of sewage to land which, although they do not show such high results, deserve attention.

Mr. Brundell, who has the management of the Doncaster Sewage Farm, states that during nine years he has never applied any other manure than sewage. That this year the crops are the heaviest that have been produced, and the land remains just as capable of receiving the sewage as it ever was, and does not "tire." Mr. Collett, of the Bedford Farm, says that their produce is generally much above the average of the neighbourhood, and that the crops are as good or better than they were seven or eight years ago; and the land under sewage treatment has improved in quality.

Mr. Champion informs me that at Reading, with sewage irrigation, they cut the Italian rye grass six and seven times in the season, as compared with two crops without sewage; that mangolds grown with sewage produce from 15 to 20 tons per acre more than when grown in the usual way: that their oat crop this year yielded from 14 to 15 quarters per acre, the straw being from 7 to 8 feet high, and remarkably stout and stiff.

Colonel Jones, of Wrexham, tells me that "having farmed many hundred acres during the last three years for the landowners who had farms thrown on their hands, I have had some opportunity of comparing actual results of farming with and without the resource to be derived from a town sewer, and I have no hesitation in saying that produce may easily be doubled per acre by the proper use of sewage as regards *any crop*, and that four or five times the weight of grass is a certainty in any season; and it is simply a question of management and market whether or not a sewage farm can be made to pay."

There are occasionally, no doubt, difficulties to be overcome in the application of sewage to land, and some eminent advocates of the conversion of sewage into manure have said that if the sea is at hand it is better to throw sewage into the sea than to utilize it. But that is not the language used in speaking of the manure of an ordinary farm; yet the one is, in its way, and under its own conditions of use, as valuable for improving crops as the other. Farmers say that one of the best ways of obtaining manure for the land is not to buy artificial manure, but to buy oil cake or other suitable food, and to feed sheep and cattle upon that; and land is largely manured by means of oil cake and Indian corn imported from abroad as food for domestic animals. A recent investigation showed that one-third of the food which is consumed by the people of this country comes from abroad; and, therefore, if we applied the sewage of our population to our land, we should enrich the land by the millions of quarters of foreign corn and the thousands of tons of foreign meat which are imported and consumed in the country; and, so far from the land of England deteriorating under such conditions, it ought to become richer year by year by these enormous importations of food. Therefore, whatever may be the trouble and expense in individual cases of applying the sewage to the land, the application, so far as the interests of the community are concerned, must add to the stored-up wealth of the country.

In the next place the diminished death and sickness rates and the greater length of life entailed by good sanitation afford direct pecuniary advantages.

Let us apply this reasoning to the population of the Improved Artizans' Dwellings in London. These now accommodate about 11,000 families.

In many of the districts which are now covered by these improved dwellings, the death-rate in the wretched homes which have been removed varied, as I have told you, from 35 to 40 and even 50 per 1,000. Mr. Gatliff shews that there are nearly five in a family on an average in Model Lodging Houses. There has thus been a saving of life to the extent of at least 20 per 1,000, by the erection of these dwellings, on the 50,000 persons inhabiting them, or about 1000 deaths annually. And if we take the estimate of sickness which I arrived at above, there would be a reduction in the number of cases of sickness which occur in the population of these dwellings of at least from 15,000 to 20,000.

The cost of the Improved dwellings appears to have averaged a little over £170 each, or about £1,900,000 for the 11,000 families.

By the light of these various data we may obtain some idea of the actual pecuniary advantage to the community which results from the improved health of the occupants of such dwellings. The cost of funerals has been stated to average £5 apiece. Under this head, therefore, the saving may be taken to average £5,000 a year; the diminished loss of the sickness of the 11,000 heads of families alone may be assumed to average another £5,000 a year; and in addition to this there would be the saving in time and money, in seeking medical attendance, of the wives and children who make up the remaining population of the dwellings, as well as the increased power of earning wages afforded to the mothers of families from the diminished sickness of the children.

Hence the money benefit to the community thus made up, which is caused by the diminished death-rate and sickness-rate, would form an appreciable item in the percentage of interest paid on the £1,900,000 capital expended in the construction of the dwellings.

But there is another way in which we may estimate the economy to the community resulting from the increased health which has been obtained in these dwellings.

The analysis of the mortuary rates for Westminster shewed that the mean age at death of the males of the wage classes in Westminster, who had survived the period of youth, and died after 20 was 47·6 years.

The rate of mortality in the Improved Dwellings is from 14 to 16 per 1,000. The rate of mortality in the rural parishes of Northumberland above mentioned, in the years 1877-81, was 15·3 per 1,000; and in Dover in 1880, it was 16·7 per 1,000. It will not be unfair therefore to take the mean age at death of the males who died over 20 in the rural parishes of Northumberland and in Dover as a standard, which may be reasonably expected, for the duration of life of the males who die over 20 years of age in the Improved Dwellings. This was, for the rural parishes of Northumberland 60·9 years, and for Dover it was 57·8 years. That is to say, from 10·2 to 12·3 years, or a mean of 11 years additional duration of life may be expected for the heads of families occupying the Improved Dwellings, beyond that enjoyed by the wage classes who do not live in such favorable surroundings.

Therefore we may assume as a profit to the community the increased earning power of the occupants of these dwellings, due to this increased expectation of life. It would appear from Mr. Neissons tables that 6 per cent. would be a full average deduction for sick time between 47 and 58 years of age; and we may therefore safely take the increased earning power as that due to an additional 10·4 years of life.

If, in order to form a rough estimate of the money value of this, we assume that each of the heads of the 11,000 families receives as a present on his admission to the dwellings a grant of ten years more life, and calculate its money value on the earnings of only £1 a week, we find that upon a four per cent. table the present value of ten years of increased wage earning power at £1 per week would be for 11,000 heads of families £4,640,000, or nearly two and a half times the cost of the property.

By considering the question in this way, we arrive at an understanding of some of the direct pecuniary advantages which accrue to the nation from those sanitary improvements which lead to a decreased death-rate and sickness-rate; and we see that however large may be the cost of the removal of bad dwellings, and the substitution in their place of healthy well-planned dwellings, the actual money gain to the community far exceeds the expenditure in money.

But it is not as a money saving alone that the question must be considered. Its social and political bearings are even more important.

The nation is made up of individual items. The goodness and the happiness of the nation depend upon the individual. Well-regulated family life does more to make up individual happiness than any other form of life. But family life is impossible in the wretched homes which have been permitted to exist in most of our large towns, and many of our rural parishes. These wretched homes drive the population into the streets, and into the gin palaces, and into the public houses. They engender sickness, which entails poverty, and they foster crime.

The improved dwellings, on the other hand, ensure improved health; and by thus affording a security for the more continuons earning of wages, create the possibility of a comfortable home. I was much struck, when in the United States of America, with the fact that the artizan and wage classes, in many maufacturing towns, lived in very comfortable houses, in which each family had their parlour with appropriate furniture, pictures, and often their piano. They had come to look upon these things as a necessity; and this is an evidence of the general civilization which pervades American society. By civilization I mean the education and the general well being of all classes.

In this country our most advanced sanitarians have long endeavoured to impress these doctrines on the public, and I am happy to think that at last they are beginning to bear some fruit; for in order to develop morality, contentment, and happiness among a people, it is essential that they should be provided with healthy and comfortable homes.

The MAYOR said he was quite sure that the meeting would agree with him that the important, interesting, and useful address which had been delivered by Captain Galton deserved their most hearty thanks. People seemed to be living in a state of considerable ignorance as to what was necessary for the promotion of their health, and the information which had been given in the early part of Captain Galton's address should result in very great benefit to the public at large. The latter part of the address was full of very interesting facts which had rather an important relation to the health of the working classes. He hoped that the spirit of advancement which he believed had been going on for some time in connection with matters of general health would be accelerated by the address they had heard that night. He had great pleasure in asking them, without making any further remarks, to give Captain Galton a very hearty vote of thanks for the valuable and interesting address he had just read.

Mr. ALDERMAN WILSON said he had great pleasure in seconding the proposal which the Mayor had made to them. It was undoubtedly a very valuable address, and he hoped that it would be profited by in every possible way. If at any future time it should occur that this valuable Institute should come among them again, he hoped that they would find that a very satisfactory state of things, in regard to the matter of health, existed in Newcastle-on-Tyne. They would find, at all events, that their death rate would be very much diminished. He had very great pleasure in seconding the motion.

Captain DOUGLAS GALTON said he was extremely obliged to those assembled for the extremely hearty manner in which they had carried the resolution. He had now formally to announce that the meeting was adjourned.

The meeting then adjourned.

APPENDIX A.—Table prepared under the Instructions of Edwin Chadwick, Esq., C.B., and Dr. Richardson, M.D., F.R.S., for a Committee of the Society of Arts, for the BOROUGH OF WESTMINSTER, 1878.

Classes of the Population.	Proportion per cent. of Total Deaths of each Class.	Proportion of Deaths from the Undermentioned Causes to 100 Deaths from all Causes. Diseases of the Respiratory Organs (including Phthisis.)	Deaths from Zymotic Diseases. Enteric Fever.	Deaths from Zymotic Diseases. Diarrhœa.	Deaths from Zymotic Diseases. Other Zymotic Diseases.	Total per cent. of Deaths of each class of Zymotic Diseases, and	Mean of all classes.	Diseases of the Nervous System.	Senectus.	Mean Age at Death of all who died; men, women, and children.	Mean Age at Death of all who died above 20 years of age.
Gentry, Professional Men, &c.:—											
Males	51·45	22·88	...	3·27	5·88	9·15	17.75	11.76	3·27	55·8	61.0
Females	45·55	25·78	0·78	1.56	1·56	3.80		16·41	3·91		65.0
Children under 1 year	6·41	11·11	...	27·78	5·56	33·31		11·11	...		...
Children under 5 years	9·96	10·71	...	17·86	7·14	25·00		10·71	...		...
Salaried Classes, Commercial Clerks, and Merchants:—											
Males	61·59	28·82	2·35	1·76	5·29	9·30	17·85	10·59	3·53	33·3	48·8
Females	38·41	30·91	2·83	3·77	6·60	13·20		8·49	1 89		50·6
Children under 1 year	15.94	18·18	...	11·36	9·09	20·45		15·91	...		...
Children under 5 years	27·54	21·05	...	9·21	19·74	28·95		9·21	...		...
Tradesmen, Shopkeepers, &c.:—											
Males	51·27	32·52	1·48	3·14	7·15	11·77	19·8	10·64	1·05	32.0	53·6
Females	48·73	33·39	0·73	2·75	9·36	12·84		10·55	2·66		56·3
Children under 1 year	21·90	24.49	0·20	9·59	9·59	19·38		11·81	...		...
Children under 5 years	38·44	26·98	0·35	6·63	18·95	25·93		10·23	...		...
Wage Classes—Artizans, &c.:—											
Males	51·94	36.42	1·35	3·06	5·85	10·26	18·37	9·26	0·72	28·9	47·9
Females	45·06	33.55	0·88	3·62	10.09	14·59		10·75	2·41		53·6
Children under 1 year	22·63	28.17	0·22	11.35	9·17	20·71		11.79	...		...
Children under 5 years	39 03	28·73	0·38	8·35	17·09	25·82		10.51	...		...
Domestic Servants, &c.:—											
Males	47·04	32·52	0·92	4·29	4·60	9·81	16·84	8·28	0·61	34·3	48·7
Females	52·96	32·15	2·45	14·36	3·51	10·35		9·64	4·09		53·4
Children under 1 year	20·35	21·99	...	5·60	7·80	23·40		10·64	...		...
Children under 5 years	30·88	25.70	0·93	12·62	10.28	23·83		11·21	...		...
Mean of all Classes:—											
Males	52·77	33·29	1·34	3·16	6·19	10.69	17·7	9.90	1·13	32.4	51·2
Females	47·23	32·77	1·11	3·27	8·30	12·68		10·68	2 80		55.4
Children under 1 year	20·89	25·20	0·17	11·38	9·12	20·67		11·82	...		...
Children under 5 years	35·71	37·08	0·41	8·23	17·12	25·76		10·42	...		...

NOTE.—The figures in this Table refer to the three Registration districts of St. George, Hanover Square, Westminster, and the Strand; whose population is very nearly the same as that of Westminster Borough. Thus the population of the Borough in 1871 was 246,606, while the Registration district had a population of 248,456, or 1,850 in excess. Total deaths in 1878 in the three Registration districts—(Males, 2,908 Females, 2,603)—5,511. Proportion of deaths to the population, 22·7.

APPENDIX B.—CITY OF NEWCASTLE-UPON-TYNE, 1881.

Classes of the Population.	Proportion per cent. of Total Deaths of each Class.	Proportion of Deaths from the Undermentioned Causes to 100 Deaths from all Causes.						Mean Age at Death.	
		Diseases of the Respiratory Organs (including Phthisis).	Zymotic Diseases.			Diseases of the Nervous System.	Senectus.	Of all who died: Men, Women, and Children.	Of all who died above 20 years of age.
			Enteric Fever.	Diarrhœa.	Other principal Zymotic Diseases.				
All Classes:—									
Males	51·83	25·76	1·15	5·71	6·01	14·46	2·98	29·4	51·9
Females	48·17	23·53	1·37	4·14	7·06	11·38	5·36		55·1
Children under 1 year	25·62	12·65	0·12	10·93	4·55	19·78	...		...
Children under 5 years	39·26	16·76	0·24	9·06	11·71	17·80	...		...
1. Gentry, Professional Men, &c.:—									
Males	54·91	26·02	2·44	4·07	4·88	14·63	3·25	35·5	53·2
Females	45·09	15·84	...	3·96	6·93	14·85	3·96		57·1
Children under 1 year	23·66	5·66	...	11·32	1·89	18·87	...		...
Children under 5 years	33·93	11·84	...	7·90	11·84	14·47	...		...
2. Tradesmen, Shopkeepers, &c.:—									
Males	51·92	30·30	1·42	4·55	4·84	14·22	2·70	31·6	54·0
Females	48·08	26·27	1·38	3·69	6·30	16·44	6·30		56·9
Children under 1 year	22·82	15·53	0·32	9·39	2·27	18·12	...		...
Children under 5 years	37·00	19·96	0·60	6·79	11·38	17·76	...		...
3. Shipwrights, Chain and Anchor Smiths, Iron Forge Labourers, &c.:—									
Males	50·00	25·51	0·51	5·61	9·18	10·20	2·04	22·3	46·6
Females	50·00	16·33	1·02	6·63	3·57	9·69	3·57		50·9
Children under 1 year	32·40	8·66	...	11·02	6·30	20·47	...		...
Children under 5 years	47·96	11·89	...	10·64	9·57	15·96	...		...
4. Seamen, Watermen, Fishermen, &c.:—									
Males	55·12	21·43	...	7·14	2·86	12·86	2·86	37·1	52·4
Females	44·88	22·81	...	3·51	5·26	12·28	7·02		57·4
Children under 1 year	18·90	8·33	...	4·17	12·50	29·17	...		...
Children under 5 years	26·77	11·76	...	8·82	14·71	26·47	...		...
5. Other Wage Classes—Artizans, &c.:—									
Males	51·34	20·58	0·90	7·40	7·04	16·43	3·61	27·0	49·9
Females	48·66	24·38	1·90	4·76	9·52	13·72	4·95		53·4
Children under 1 year	27·90	12·96	...	12·96	5·98	20·60	...		...
Children under 5 years	41·52	15·18	...	11·16	12·72	18·53	...		...

Total Deaths in 1881 .... 3,176 {Males .... 1,646, Females ...... 1,530.

Estimated Population in middle of year .... 145,811.
Mortality per 1,000 in year 1881 .... 21·8.

APPENDIX C.—BOROUGH OF DOVER, 1880.

Classes of the Population.	Proportion per cent. of Total Deaths of each Class.	Proportion of Deaths from the Undermentioned Causes to 100 Deaths from all Causes.						Mean Age at Death.	
		Diseases of the Respiratory Organs (including Phthisis.	Zymotic Diseases. Enteric Fever.	Zymotic Diseases. Diarrhœa.	Zymotic Diseases. Other principal Zymotic Diseases.	Diseases of the Nervous System.	Senectus.	Of all who died; Men, Women, and Children.	Of all who died above 20 years of age.
All Classes:—									
Males	52·43	30·74	0·74	7·76	1·85	11·85	7·41	34·1	57·8
Females	47·57	31·43	1·63	6·94	3·67	15·10	8·57		59·6
Children under 1 year	26·99	20·86	...	19·42	0·72	14·39	...		...
Children under 5 years	37·28	25·52	...	16·67	5·21	13·02	...		...
Gentry Professional Men, &c.:—									
Males	43·94	17·24	6·90	13·79	...	17·24	10·34	42·8	64·7
Females	56·06	21·62	8·11	5·41	5·40	18·92	16·22		64·9
Children under 1 year	13·64	11·11	...	55·56	...	11·11	...		...
Children under 5 years	25·76	17·65	...	29·41	5·88	17·65	...		...
Tradesmen, Shopkeepers, &c.:—									
Males	48·66	31·87	...	6·59	...	14·29	5·50	31·9	61·0
Females	51·34	33·33	...	7·29	6·25	16·67	4·17		53·4
Chi dren under 1 year	27·27	19·61	...	17·65	1·96	17·65	...		...
Children under 5 years	40·64	23·68	...	11·47	7·89	15·79	...		...
Wage Classes—Artizans, &c.:—									
Males	58·04	34·62	...	7·69	3·85	9·23	8·46	33·6	55·0
Females	41·96	35·11	1·06	8·51	...	12·77	6·38		60·1
Children under 1 year	29·46	25·76	...	18·18	...	12·12	...		...
Children under 5 years	36·16	30·86	...	18·52	2·47	9·88	...		...
Seamen, Boatmen, Pilots, &c.:—									
Males	52·63	20·00	...	5·00	...	10·00	5·00	32·9	52·5
Females	47·37	22·22	...	...	5·56	11·11	27·78		78·0
Children under 1 year	34·21	7·69	...	7·69	...	15·38	...		...
Children under 5 years	47·37	16·67	...	5·56	5·56	11·11	...		...

Total Deaths .... 515 {Males .... 270. Females .... 245.}

Annual Rate of Mortality per 1,000 of Population in 1880 .... 16·7.

APPENDIX D.—RURAL PARISHES OF NORTHUMBERLAND, 1877—81.

Deaths in the five years 1877—81, in parishes comprised in the Registration Districts of Bellingham and Rothbury, and in the Sub-districts of Islandshire and Norhamshire, in the parish of Chatton.

Classes of the Population.	Proportion per cent. of Total Deaths of each Class.	Proportion of Deaths from the Undermentioned Causes to 100 Deaths from all Causes.						Mean Age at Death.	
		Diseases of the Respiratory Organs (including Phthisis).	Principal Zymotic Diseases.			Diseases of the Nervous System.	Senectus.	Of all who died; Men, Women, and Children.	Of all who died above 20 years of age.
			Enteric Fever.	Diarrhœa.	Other principal Zymotic Diseases.				
All Classes:—									
Males	50·43	19·51	1·84	1·84	6·50	12·03	10·06	42.3	60.9
Females	49·57	23·35	1·50	2·25	7·62	12·61	9·61		59.9
Children under 1 year	15·72	13·78	...	5·12	6·69	6·30	...		...
Children under 5 years	22·46	13·22	0·55	4·13	16·53	6·61	...		...
Gentry, Professional Men, &c.:—									
Males	44·83	11·54	3·85	...	3·85	15·39	19·23	55.7	65.5
Females	55·17	25·00	...	...	...	18·75	12·50		70.8
Children under 1 year	8·62	40·00	...	...	20·00	...	...		...
Children under 5 years	10·34	33·33	...	...	16·67	...	...		...
Farmers, &c.:—									
Males	60·00	19·30	1·75	0·88	3·51	9·65	12·28	52.6	66.1
Females	40·00	23·68	1·32	2·63	5·26	10·53	14·47		66 8
Children under 1 year	10·00	15·79	...	...	5·26	5·26	...		...
Children under 5 years	14·74	17·86	...	3·57	10·71	3·57	...		...
Tradesmen, Shopkeepers, &c.:—									
Males	51·20	21·70	2·98	0·85	5·96	16·17	10·64	43.8	59 2
Females	48·80	21·43	...	1·34	10·71	15·63	7·14		60.4
Children under 1 year	13·07	13·33	...	1·67	13·33	11.67	...		...
Children under 5 years	20·48	11·70	...	1·06	24·47	10·64	...		...
Wage Classes—Artizans, &c.:—									
Males	46·49	19·11	0·89	3·56	7·56	11·11	4·89	35.4	56.0
Females	53·51	21·24	1·93	2·70	8·49	12·36	10·04		57.3
Children under 1 year	21·49	14·44	...	9·62	1·92	4·81	...		...
Children under 5 years	28·72	12·23	0·72	7·91	14·39	6·47	...		...
Agricultural Labourers, &c:—									
Males	50·59	18·60	1·40	1·86	7·91	9·30	12·56	42.2	63.7
Females	49·41	27·62	2·86	2·86	5·24	9·52	9·52		57.7
Children under 1 year	15·53	10·61	...	3·03	7·58	4·55	...		...
Children under 5 years	22·59	13·54	1·04	2·08	13·54	4·17	...		...

Gentry, &c. ... 58 | Wage Classes ... 484
Farmers, &c. ... 190 | Agricultural Labourers ... 425
Tradesmen, &c. ... 459

Total Deaths ... 1616 { 815 Males. 801 Females.

Population 1871 ...23,139. Population 1881...20,666.
Mortality per 1,000 calculated on deaths and estimated population in each year 1877-81... 15·3.

APPENDIX E.—Annual rate of mortality per 1,000 of population at several ages in the City of Newcastle-upon-Tyne during the year 1881, and in the Borough of Dover in the year 1880.

Ages.	Newcastle-upon-Tyne, 1881.		Dover, 1880.	
	Males.	Females.	Males.	Females.
All Ages.	23·15	20 60	18 13	15·37
0 — 5	66·19	54·77	62·64	44·43
5 — 10	8·84	7·36	3·38	1·80
10 — 15	4·35	3·79	7·06	2·68
15 — 20	5·08	5 10	4·09	4·08
20 — 25	6·00	6·82	6·07	4·98
25 — 35	10·67	8 95	6·20	5·07
35 — 45	17·71	14·88	9·42	10 07
45 — 55	27·11	17·05	12·11	10·02
55 — 65	44·89	32·81	31·91	25·41
65 — 75	88·97	80·72	53·31	42·11
75 — 85	206·01	177·48	183·65	117·72
85 and upwards.	276·90	215·83	430·63	190·89

NOTE.—The numbers of the population at the various ages, as enumerated at the Census of 1881, are not yet available. For the purposes of the above table it has been assumed that the distribution of the population over the several ages was relatively the same in 1881 as in 1871.

APPENDIX F.—Mean age at death and mean after life-time or expectation of life, at several ages, deduced from the estimated mortality of the City of Newcastle-upon-Tyne in the year 1881, and of the Borough of Dover in the year 1880. The expectation of life by the English Life Table is added for comparison.

Ages.	Newcastle-upon-Tyne, 1881.				Dover, 1880.				By the English Life Table.	
	Mean age at death.		Mean after life-time.		Mean age at death.		Mean after life-time.		Mean after life-time.	
	Males.	Females.	Male	Females	Males	Females.	Males.	Females.	Males	Females
0	39·1	43·7	39·1	43·7	44·5	52·1	44·5	52·1	39·9	41·9
5	52·6	55·9	47·6	50·9	59·9	63·9	54·9	58·9	49·7	50·3
10	54·7	57·8	44·7	47·8	60.8	64·5	50·8	54·5	47·1	47·7
15	55 6	58·6	40·6	43·6	62·6	65·2	47·6	50·2	43·2	43·9
20	56·6	59·7	36·6	39.7	63·5	66·1	43·5	46·1	39·5	40·3
25	57·6	61·0	32·6	36 0	64·8	67·2	39·8	42·2	36·1	37·0
35	60·7	63·9	25·7	28·9	67·0	69 2	32·0	34·2	29·7	30·6
45	64·8	67·7	19·8	22·7	69·7	72 3	24·7	27·3	22·8	24·1
55	69·3	71 0	14·3	16·0	72·2	74 6	17·2	19·6	16·5	17·4
65	74·6	75·3	9·6	10·3	76·8	78·9	11·8	13·9	10·8	11·5
75	81·3	81 8	6·3	6·8	81·6	83·5	6.6	8·5	6·5	6·9
85	90 5	90·1	5·5	5·1	90·1	91·5	5·1	6.5	3·7	4·0

SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS

By Dennis Embleton, M.D., F.R.C.P.,

PRESIDENT OF THE SECTION.

I have the honour and pleasure of offering to this Section of the Sanitary Institute of Great Britain, on its first visit to Newcastle-upon-Tyne, a hearty welcome.

We are assembled at an important station, which dates back from the times of Hadrian, and even from those of the Ancient Britons, and which has been celebrated more or less ever since in British history for its natural productions, its important and successful industry in various departments of the arts and sciences, its extensive commerce, its learning and its antiquities. It has passed successively under the appellations of Pons Œlii, Ad Murum, The New Castle on the Tyne, Novum Castrum super Tyna, and during the last month Her Gracious Majesty has distinguished it by the more elevated style and title of "The City and County of Newcastle-upon-Tyne." Lastly, it has been further dignified by having also about the same time been constituted the seat of a new Bishopric.

Its glories, so long ago as the time of the publication of Grey's "Chorographia," were summed up in the Latin distich:

> "*Portus, Castrum, Carbo, Salmo, Salina, Molaris.*
> *Murus, Pons, Templum, Schola, sunt Novi gloria Castri.*"

I have also the pleasing duty to perform of tendering to you my thanks for the honour you have conferred upon me by placing me in the high position of President of this Section of Sanitary Science and Preventive Medicine.

I fear that I have nothing new to offer you, and you know that "*Difficile est proprie communia dicere.*" So I must beg your indulgence in listening to that which I have to say.

The objects of the Sanitary Institute of Great Britain are, as I apprehend them, to increase, and to reduce to practical use, our knowledge of the best means of improving the sanitary condition of our dwellings in towns and in the country, of our men and women, poor and rich alike; to diffuse such knowledge broadcast over the land, so that every one who will may learn, and those who will not must follow in the wake of their wiser brethren, and be taught what are the best ways of living long and in health, that all being instructed and convinced may gladly assist in carrying out, for the public and private weal, those means which experience and science have proved to be the most advantageous. To enlighten sanitary authorities and aid them by advice; to examine and grant certificates of competence to Local Surveyors and Inspectors of Nuisances, and to those who may be candidates for these offices; to endeavour to obtain a complete registration of diseases, and particularly of those that are preventible.

The last of the objects of the Sanitary Institute is to hold a Congress from time to time, to allow of the consideration and discussion of subjects relating to Hygiene.

Wherever the Congress meets there is held an Exhibition of all manner of Sanitary apparatus and appliances for the instruction of all concerned—and who is not?—in the principles and practice of Hygiene.

In kindling and diffusing this light, it will readily be allowed that members of the medical profession have been prominently and honourably distinguished, and although in so doing they have not consulted their own worldly advantage, they have incurred no small amount of ill-will and obloquy from the blind and ignorant part of the public whose very interests they were promoting.

Sanitary improvements used formerly to be scouted as unnecessary, or stigmatized as positively injurious. Even now they are at first unpalatable, and even grievous to many, owing to the not unnatural tendency to a dislike to depart from old ideas and ways, and thereby incur increased expenditure of money; but once enforced, they are tacitly or grumblingly acquiesced in: after a while they are confessed to be unexpected blessings, by conferring or augmenting health, comfort, and convenience, and, lastly, the wonder grows that the improvements had not been enforced much earlier.

To become more healthy, men must be taught that it is necessary to sacrifice many little items of what they have been accustomed to regard as their right—their personal liberty—for they are bound, both by human and Divine laws, to have regard to the health and comfort of their neighbours—the community—as well as to their own.

Private convenience must give way to public good.

Salus populi suprema lex! This apophthegm is as true now as when, in ancient Rome, it was enunciated; and its value, in those days clearly apprehended, ran great risk of being entirely lost to mankind in the wars, tumults, and confusions of the dark ages, and is only now, in this latter half of the nineteenth century, beginning to be re-appreciated and re-understood, and the important principles involved in it to be again carried into action.

The idea of the supreme importance of the health and safety of the people has not, as yet, penetrated so deeply into the public mind as to render the repetition of the above wise and terse dictum unnecessary; and perhaps even yet it has not been adequately studied and carried into act by those in authority.

It is true that during recent years considerable and increasing progress has been made; sanitary laws have been framed and extended; courses of study and examinations have been instituted by universities and medical schools, as well as by our Institute, and distinctions offered for proficience in state medicine or sanitary science; health authorities, health officers, and nuisance inspectors have for all urban and suburban districts been appointed;—and all are being instrumental in furthering the cause of sanitation. Valuable and regular reports are made of the condition of the districts, and these are compared, summarized, and tabulated by proper officers; and thus local authorities are enlightened as to their duties of caring for the health of the public.

Many prejudices, however, remain to be combatted, and many difficulties from previous faulty constructions and other causes to be surmounted.

In this city many great and beneficial alterations have of late years been effected by the abolition of groups of unhealthy houses, many of which were quite unfit for human beings to live in; by the regulation of lodging-houses and diminution of overcrowding; by the opening out of narrow lanes into spacious streets, by rectifying old streets, by forming new thoroughfares; by extended and improved sewerage; by an improved and increased supply of water and of gas; and by the formation of five parks at different parts of the circumference of the city for the recreation of the inhabitants.

Our population, which, in my boyish days, numbered about 35,000, has increased to close upon 150,000, and the death-rate during the last 50 years has notably decreased: the latest return showing that the annual rate for 1881 was 21·8 per 1,000.

From the returns of the Registrar-General for 1881 we learn that the lowest mortality among 20 large towns was 19·0 per 1,000 at Brighton; the highest 26·7 per 1,000 at Liverpool. That in 50 other large towns represented by the entire registration districts or sub-districts most nearly corresponding with their boundaries, the death-rate last year averaged only 19·6 per 1,000, which was 2·1 below the average rate in the 20 larger towns. The lowest rate in these 50 towns was 14·2 at Reading, 14·3 at Maidstone; and the highest, 24·0 in Ashton-under-Lyne, and 24·6 in Merthyr Tydfil.

Our mortality last year, 21·8 was somewhat less than in any of the preceding five years, and yet 13 out of the 20 towns on the list of the Registrar-General had a lower death-rate than we had, and only 6 a higher rate. This is not an honourable position for us.

The 13 towns must have been improving in salubrity, and hence we may appear to have retrograded, whereas, as I have just said, our rate had diminished; we have been improving, but only less rapidly than the 13 other towns.

There is, therefore, room for further improvement in our sanitary condition, and that may be effected by the prevention or stamping out of zymotic diseases, by the total abolition of fever dens, the stricter regulation of houses liable to be overcrowded, by extended drainage of houses, and by the inculcation of sanitary knowledge among the people, and the preservation of the lives of young children, especially those under the tender age of five years.

Pure air, or air as pure as can be had, is essential to the health, cleanliness, and comfort of the inhabitants of all towns. The seats, however, of our great manufacturing industries suffer grievously at times from the plague of smoke. We know that the consumption of vast quantities of coal in various factories is an absolute necessity; but it is also well known that these valuable establishments can be carried on with a very great reduction of the amount of smoke at present produced, and that means exist whereby smoke from factories may practically be abolished.

This smoke, in certain localities, contains not merely the products of the combustion of coal—the valuable, unburnt, and therefore wasted carbon, the carbonic acid and oxide, and the sulphurous acid—but, moreover, the fumes of hydrochloric acid, of lead, copper, arsenic, and other unwelcome vapours.

An atmosphere charged with these malodorous and mephitic additions cannot be supposed to be particularly salubrious; it certainly does not possess antiseptic qualities sufficient to ward off infectious or zymotic diseases; if it did it might be endured with some degree of patience and resignation, as it is it is a great evil and demands abatement. It blackens our streets and buildings, our faces, hands, and clothes, our books and silver-plate, it penetrates our air passages and lung cells, giving rise to feelings of choking and to sooty expectoration, it induces general depression and constipation, it injures and destroys our trees and damages our crops. It would be an immense benefit both to town and country if the smoke could by any means be reduced to the smallest amount compatible with the carrying on of profitable business. We have laws framed with the object of getting rid of smoke, but they seem inoperative. None but those whose necessities require it live in smoky towns, and these so soon as they have acquired a competency go to live and spend their money in more favoured and cleaner localities; even the denizens of a smoky town seize every opportunity to get into purer air, either at the sea-side or in the country.

Good water is almost as essential as good air, and great efforts have been made of late years to obtain it, for large towns, from the streams and lakes of mountain districts, since the rivers have become so polluted that their water is no longer potable.

The variety of artificial drinks—aqueous—goes on increasing, and when they are properly and conscientiously prepared, are good and wholesome.

The consumption of alcoholic drinks goes on diminishing, and with the quantity the quality of some is also reduced.

Intemperance in the use of these is on all hands, and justly, condemned, and considered the parent of poverty, vice and misery, bringing forth quarrels among friends, violence, insanity, suicide, and various forms of disease, and in this way the lives of thousands are embittered and cut short, long before even the term assigned by the Psalmist has been attained. It would be well if the smoking of tobacco were restricted to men and women above the age when the body is fully formed.

A supply of pure milk is essential to the welfare of every modern community, and especially of young children, but it is now so dear that poor folk's children are obliged to be brought up without its healthy nutriment.

The inspection of dairies ought to be constantly and carefully performed, for it is well known that from carelessness and want of cleanliness during the transit of milk from the cow to the consumer the seeds of disease have found their way into the wholesome nutriment, and been sown far and wide through families, whose darlings have thereby been cut off on the threshold of life. Milk being already a watery fluid, no additional water should be allowed to be mixed with it by the vendor, as the consumer can easily do that if he considers it requisite.

Meat—animal and vegetable—is as necessary as drink, and temperance in its use is also as requisite. Inspection of both kinds, and analyses in many cases, ought to be in constant operation. Medicines also require to be tested in the interest of the sick and of the medical attendant.

The *auri sacra fames* has led to the systematic adulteration of various kinds of food and of medicines, and the adulterators deserve to be fed on their own cheap and nasty compounds.

Cookery, properly so called, is the art of preparing food so as to render it at once easily digestible and agreeable to the tongue. The cookery of the plain cook does not commonly aim at these desirable ends, but is often the art of getting over the preparation of the meal with the smallest amount of trouble to the cook. Most houses are in need of lessons of sanitary cookery. The disturbing influences of bad cooking and the habit of bolting food tend to dyspepsia and to shorten life, whilst good cookery and thorough mastication of food are among the agencies that tend to prolong existence.

Cleanliness of person and purity in the house, thorough sewerage of towns, and perfect drainage of houses, are absolutely necessary for health. The sewers and drains must be thoroughly ventilated, and the products of the ventilation carried away to the most elevated situations outside the towns and houses, and should never be permitted to escape by open grates in the streets in the midst of the moving population, whose health it is the object of sanitary authorities to protect and promote. It is true that it is better for the foul gases to pass out into the streets than into the houses, but if they exude into the thoroughfares the air in them can never be pure.

Every one will agree that if infectious disease of any kind makes its appearance, means should be at once adopted and energetically followed out, to limit its spread and to stamp it out at the earliest possible period.

Not long since the notification to the authorities of the breaking out of infectious disease was considered impracticable and absurd, now, however, it is looked upon, and very properly, as not only feasible, but absolutely necessary, and a fit subject for imperial legislation.

On the subject of the compulsory notification of infectious diseases it is a question whether the master or occupier of the house, the head of the family, or the medical attendant, if there be one, should notify to the sanitary authorities the occurrence of such disease. It seems only in accordance with reason that the person in whose house the disease may have appeared should in the first instance be obliged to notify the fact if he is aware of it, for such person is most directly and seriously concerned, and he and his family are the most likely to suffer from infection; besides he is bound in duty to his neighbours and to the community to take the best measures to prevent the disease spreading to them.

If a medical man called in finds an infectious disease present he must inform the master of the house that such exists, and direct him how and when to make the necessary notifications; if he is requested by the master of the house to notify for him the medical man cannot well refuse to do so; if the master of the house refuses to notify, or to allow the medical attendant to do so for him, then the onus must fall upon such master after he has been told what his plain duty is.

If no medical man is sent for or allowed to attend, then the master of the house is clearly responsible, and must abide the consequences of his neglect if he does not at once notify the existence of infectious disease in his house to the proper authority.

Those who unfortunately happen to have any infectious disease in their houses ought to be very thankful to a medical man who will notify for them, instead of placing obstacles in his way.

It is most important that children having an infectious disease should not be allowed to go to school, nor should those from any house in which such disease exists be allowed to go to any school. The disease should be limited to as small a space as possible, not brought among circumstances which would be most favourable for its spreading through a community; adults going about with infectious diseases upon them are liable to punishment.

Vaccination should be repeated every 7 or 10 years to ensure immunity, and the greatest care taken to obtain the vaccine matter at the proper time, and from a healthy subject belonging to a healthy family.

With regard to female attire—the vagaries of fashion are not easy to be controlled, some of them, however, are so very absurd, ridiculous, and withal so injurious to health and destructive of elegance of form that they deserve to be on all occasions held up to public derision and reprobation. I allude to the tight lacing of the waist with stays, and the wearing of high-heeled boots and shoes as practised by some ladies.

The spider, or the wasp, or the hour-glass, is not a fit model for the human form, and moreover the spider-waisted girl or woman is certain to have all her internal organs displaced or compressed and deformed, and she thereby becomes unfitted for the duties of a mother. The high-heeled boot is not an imitation of anything in nature, it is an absurdity *sui generis*, a revival of an old fashioned folly of a century ago: it deforms and injures the foot, and spoils the beauty and usefulness of the leg. These two absurdities render impossible that free exercise of the body, which is so essential to health; they sap the health, undermine the constitution, and tend to bring on premature age.

The question, what is the natural term of life of man? is one that naturally occurs, and is of deep interest to the student of Sanitary Science and Preventive Medicine. What is the philosophic estimate of the normal length of his life? How long does he actually live under the most favourable circumstances at the present day?

With respect to the former of these questions the answers we get from high authorities on this subject present some variety; but those we obtain to the latter question show a greater and more reliable consensus.

Buffon, from the physiological knowledge of his day, concluded that the duration of life may be estimated to a certain degree by that of the duration of an animal's growth, "Man, who takes 30 years to grow, lives 90 or 100 years; the full development in size of all the parts of his body is not completed till the 30th year—his life, therefore, is the period of his growth multiplied by $3\frac{1}{3}$."

The ages of the dog, horse and stag may be computed by taking the years of their attaining maturity, and multiplying them by 4, 5, 6, or 7 respectively.

Flourens, following in the footsteps of the great naturalist just named, but with a more advanced physiology, gives us more and more accurate information: he informs us that the ages of Mammalian animals at which they die a natural death from decay may be computed by ascertaining the time at which they arrive at perfect maturity and multiplying their age at that time by five. According to this rule, the illustrious Professor Owen has ascertained, as related by my friend the benevolent and eloquent Dr. B. W. Richardson at the Croydon Congress, the natural age of a number of wild and of domesticated animals, as the Elephant, the Horse, the Lion, the Ox, the Camel, and so on.

The same rule was applied to man, whose full maturity and full age may, Dr. Richardson tells us, be calculated with equal precision. His maturity, *perhaps not quite the full maturity*, is twenty years. His full age, therefore, is 100 years. "This," he goes on to say, "is the anatomical estimate of human life, the surest, and by far the best of all that can be supplied, since it defines a law irrespective of, and overriding all those accidental circumstances of social and physical storm and strife which may interpose, and indeed do interfere, with every estimate based on the career of life itself, as it is shown in the ephemera by and through whom it is phenomenally demonstrated."

"This lesson told with singular felicity of language from two masters of science—for Owen never forgot Flourens—struck Mr. Chadwick and myself with singular force. On a surer basis than we had ever trod, it corroborated a view we had ourselves promulgated from entirely different standpoints, and it further corroborated a similar view which had been advanced by our eminent friend Dr. William Farr. The constant of human life is naturally one hundred years. The constant was before us in all its truthfulness. But more remains."

"Because the fulness of age is one hundred years, it is not an essential that death shall immediately crown the advent of that fulness. To certain parts of the scheme of natural life there is a boundary. The period of maturity of development has its boundary of twenty years; when the body, as Flourens says, ceases to grow, it does not cease to increase; its nutrition improves and perfects for twenty years more at least, and then has only reached its completed physical condition. It should never during that period gain in weight, and for a long time it should not lose. It goes on now through a third period, which Flourens admirably calls the period of invigoration, during which all its parts become firmer, all its functions more certain, all its organisation more perfect; and this period covers thirty years. At seventy years old age begins; the *first* old age in which naturally the fruits of wisdom are most bountifully developed, and which lasts from fifteen years to twenty, to mellow down to a period of ripe old age, commencing at eighty-five years, and lasting fifteen years more, *i.e.*, until the constant is attained."

"And yet there need not yet be death. The kind of half life consisting of forces *in action*, without any *in posse*, has continued unquestionably many years beyond the fulness of age, both in man and lower animals, and to give it twenty years beyond the natural hundred is to be just without being in any extreme sense generous."

It is not for me to enter the lists against the high authorities whose names I have taken the liberty of mentioning, but it is to be observed that the theory of Professor Flourens of completed animal growth is founded on the union of the epiphyses of the bones to their shafts, in other words, "the determination of natural old age is calculated on the basis of *perfected maturity*. The skeleton is *perfected* when the epiphyses or loose terminal parts of long bones are firmly united with the shaft of the bone."

Now on reference to our latest standard works on human anatomy we find it laid down distinctly that the perfected maturity of the skeleton of man as regards *the length* of bones is not arrived at till the age of 25 years.

In the last edition of Quain's Anatomy, in 1878, we are told that the long bones of the extremities, which are always the last to terminate their ossification, are not completed, that is, their epiphyses are not thoroughly consolidated with their shafts, before the age, in woman of 23 or 24 years, and in man of 25 years.

In the *Traité d'Anatomie descriptive, &c., Ph. C. Sappey, 2nd Edit. Vol. I.* p. 112, *Paris*, are the following passages:—

"*La réunion des épiphyses a lieu un peu plus tôt chez la femme que chez l'homme. Chez la première toutes sont soudées à vingt-deux ans. Chez le second les dernières ne se soudent quelque fois qu'à vingt-trois, vingt-quatre et même vingt-cinq ans.*

"*Après la soudure des épiphyses la longueur des os n'augmente plus. Or, cette soudure est complète à vingt-cinq ans, et la stature cependant continue à croître jusqu'à vingt-huit ou trente.*

"*Comment s'opère cet accroissement auquel le système osseux ne peut plus contribuer? On ne saurait invoquer ici que les cartilages articulaires et les disques intervértebraux; ces derniers surtout, dont l'evolution sans doute est plus tardive que celle des os, et qui augmente encore d'epaisseur lorsque ceux-ci ont déjà acquis leur longueur définitive.*"

At p. 113:—

"*Ainsi se produisent et s'agrandissent ces canaux* (*médullaires*), *ainsi s'accroît le diamètre des os longs. Cet accroissement ne se termine qu'à vingt-huit ou trente ans, chez la femme; a trente-cinq ou quarante ans chez l'homme. Les os par conséquent continuent à croître en grosseur longtemps encore après qu'ils ont cessé de croître en longueur.*"

If these data be correct and man does not come to full maturity, as regards the length of the long bones and the consolidation of their epiphysis, until the age of 25 years, and we apply the rule of Professor Flourens, multiplying 25 by 5, we get the result that the constant of the length of human life should be 125 instead of 100 years.

Again, if we take the period at which the bones of the skeleton have arrived at their full development of thickness and strength, as well as of length, when, in fact, they are entirely and finally perfected, that is at 40 years, and apply the above rule to this number, we should find that the constant of the age of man ought to be extended to 200 years, and we might add, with Dr. Richardson, that if at the expiration of that lengthened period "there be sufficient vital force in action," man may live 25 or 30 years longer, and die at possibly 230 years.

If, however, the rule of Professor Flourens as applied to man be altered slightly, and the multiplicator be, in his case, made 4 instead of 5, we should then have the constant, so called, of the life of man 100 years, a number which appears to be a favourite with many philosophers.

Hufeland has laid down the rule, that an animal lives eight times as long as it is in growing. Man in a natural state requires, he states, quite 25 years to attain his full and complete growth and conformation (agreeing in this with Quain and Sappey) and this proportion will give him an absolute age of 200 years—an age exceeding that of the chief Hebrew Patriarchs, who lived from 110 to 180 years.

Dr. Latham, in his Dictionary, quoting Calmet, states that by some of the ancients, a generation was fixed at 100 years, by others again at 33, 30, 25, and 20 years. But we do not know on what these conclusions were arrived at. Dr. Farr says that the natural life of man is a century, and that the Etruscans made 100 years their sæculum.

Now although the term of 100 years be the favourite constant of human life, there are some who question the correctness of this conclusion. I will quote one.

Mr. G. H. Lewes, in his "Physiology of Common Life," Vol. II., p. 438, says on this subject—

"And here it may be as well to point out a common error in works that treat of longevity, and one which is explicitly stated by Prof. Flourens, the latest writer on that subject. It is that of supposing the duration of life to be measurable by beats of the pendulum. We are told that the normal length of life for a human being is one hundred years; and that if the majority of men die earlier, it is because accident, disease, or imprudent habits, have shortened the term.

"The argument rests on the fallacy that because some men reach the age of one hundred all men would reach it were there not disturbing causes; but inasmuch as these disturbing causes are part of the conditions of human life, inasmuch as man is dependent on the atmosphere, on climate, and on food, and cannot escape their variations, to say that he would live a century were it not for the disturbing influences, is to say that he would enjoy a longer life if life were otherwise ordained. One man lives faster than another; he lives more in the same period. If he live imprudently at the same time he may hasten the changes which will bring about death. But the utmost prudence will not shield him entirely against external conditions; nor will the wisest care do more than modify the hereditary disposition which he brought with him into the world, and which will make him short lived or long lived." In another page he says (p. 439), "The prolongation of human life has been one of the dreams of the speculative, and its essential error has been seldom perceived."

Having now seen what, according to our highest authorities on longevity, the length of human life ought to be, free from accidents and the various other disturbing influences, let us try to ascertain what it really has been, and is now, in the midst of the wear and tear of the world.

The estimate of a generation arrived at by the ancient Egyptians is recorded by Herodotus in chapter 142 of the 2nd Book (Euterpe) of History (Cary's Translation). "Thus much of the account the Egyptians and their priests related, showing that from the first king to this priest of Vulcan who last reigned, were three hundred and forty and one generations of men; and during these generations there were the same number of chief priests and kings. Now three hundred generations are equal to ten thousand years, for three generations of men are one hundred years."

If the information received by Herodotus was correct, the computation of a generation of 33⅓ years must have been nothing new at the time, but had been familiar to the Egyptian priests for ages previous, so that the mean age of the highest class of Egyptian Society was 33⅓ years: what was the corresponding age of the lower classes we know not, but it must have been considerably below that of the kingly and priestly castes.

The estimate of the Psalmist is above that of the Egyptians, but below that of modern philosophers, when he says "The days of our years are three score years and ten; and if by reason of strength they be four score years, yet is their strength labour and sorrow; for it is soon cut off and we fly away."

Men in his day evidently did not arrive at the modern constant of human life, 100 years.

To come to modern times and our own country. In a little work, entitled "Statistics of Families in the Upper and Professional Classes of the National Life Assurance Company," kindly sent to me by Mr. Charles Ansell, Jun., Actuary, dated 1874, I find the following: "The length of a generation in the sense here intended is the mean period that elapses between the births of parents and the births of their children, or, in other words, the number of years that persons are, on the average, younger than their fathers and mothers." From Mr. Ansell's tables it results that "the average intervals between the births of fathers and mothers and the births of their children are 36·66 years for fathers, and 32·30 years for mothers respectively. The mean of these intervals is 34·48 years.

For all practical purposes, therefore, it may be considered that the average length of a generation among the upper and professional classes, in this country was, in 1874, 34½ years."

It is not a little remarkable that there should be found so close an agreement between the estimate reported by the father of history, in B.C. 450, and possibly arrived at ages before, and that made only eight years ago by the actuary of an English life assurance society. The ancient Egyptian priests, giving 33⅓ years as the length of a generation by the banks of the Nile, and the modern actuary assigning 34½ years as the length of the same in the upper and professional classes of England.

It may be objected that the Egyptian estimate relates, not to a generation as defined by Mr. Ansell, but to the mean duration of human life; but it is curious to observe how closely the length of a generation, as given by this gentleman, agrees with the mean duration of human life in England as recorded by our authorities, in short, it seems identical with it. Again, in Lardner's "Museum of Science and Art," vol. viii., 1854, it is stated that the mean duration of human life in England and Wales, during the forty years ending with the year 1840, varied from 31 to 37 years, the variation, however, not being regular, its mean value being 34 years. Further, Dr. Farr, in the Sixteenth Annual Report of the Registrar-General, 1833, says, "The natural term of human life appears to be a hundred years: and out of the annual generations successively born in England and Wales, a few solitary individuals attain that limiting age, the rest dropping off year by year as age advances, so that the mean life time is at present only 41 years."

In his Thirty-fourth Annual Report, that for 1871, Dr. Farr gives the mean age at death of persons born in England at 40·86 years.

In the supplement to his Thirty-fifth Annual Report he states: "There is finally a relation betwixt death and the mean life time of man; if a life passing through a given time is represented by a line, death is the point of termination, as birth is the point of origin."

"And a generation of men born together is represented by an indefinite number of such lines of life. The natural lifetime of man is a century; that age, under ordinary conditions, is, as the Etruscans remarked, attained by at least *one* in every considerable generation, and they made it their sæculum; as in that time are passed through all the phases of childhood, youth, manhood, maturity, and monumental age."

"The mean life-time in the healthiest districts of England, and in the healthiest ranks is 49 years, and we have no evidence that under the most favourable conditions it exceeds 50 years."

I may, however, be permitted to show that under peculiarly favourable circumstances the average mean duration of life, in certain classes of our population, may be considerably higher than that given by the Registrar-General; and I am enabled, through the kindness of John Anderson, Esq., the Resident Secretary, in this city, of the Scottish Widows' Fund Life Assurance Society of Edinburgh, to give the following particulars.

It appears, from reports specially drawn out by the chief medical officer of the society in Edinburgh, that during the sixty-six years of the operations of the society, that is, from 1815 to 1880, there had occurred 8,305 deaths, the ages of twenty-eight of which, dying between the years 1815 to 1852, were not given. Of the 8,277 deaths remaining of those assured, we find the average age to be 57·176.

"This appears high," Mr. Anderson says; "but of course they are all selected adult lives, and the average must of necessity be higher than that of the general population, having the infantile mortality to weigh it down. I observe, and it may be interesting for you, under the circumstances, to notice it, that the per centage of deaths from epidemic, endemic, and contagious diseases, has been gradually decreasing."

The details of the above reports also show that the mean duration of the lives of the assured has, during the sixty-six years above mentioned, notably increased.

These reports show that the limit assigned by the Registrar-General to the actual mean duration of the life of persons of the whole population has, in this particular instance of selected adult lives, been exceeded by seven or eight per 1,000.

The persons assured in this office belong to the upper, and upper middle classes of England and Scotland. The above results testify to the prudence and caution of the officers of the Scottish Widows' Fund Society.

The actual average duration of man's life, though here at least it shows a gradual and slow increase, comes up to only about one half of the estimate of our physiologists, the disturbing agencies of the world acting with fatal certainty on the thread of human life.

It is true that every now and then some individual, male or female of unusual strength of constitution—perhaps hereditary, arrives at the estimated century, and even goes beyond it.

The Yorkshireman, Henry Jenkins, is said, and it is generally believed, to have been 162 or 163 years old, and Old Parr 152; and lists have been drawn up of persons whose ages have extended up to 185 years, and one is stated to have had the more than patriarchal age of 207 years, surpassing even the estimate of Hufeland, but it may fairly be doubted that these last have been sufficiently authenticated.

Now if the constant of human life be 100 years, how does it happen that the actual mean life time does not come up to near the Psalmist's report, and is only, under the most favourable circumstances, equal to a litttle more than the constant—that the half of the thread of life is prematurely cut off, that the golden bowl is broken before it has been half filled at the cistern of life?

The answer is not only that man does not live aright, but also that adverse circumstances, as those of air and water, climate and food, are against him, and he cannot altogether escape accidents and diseases.

Man is careless, self-confident, headstrong, slow and unwilling to learn, and intemperate in all his enjoyments; the consequence is that he renders himself much more easily assailable by the opposing and adverse circumstances by which he is constantly surrounded, and from which even a prudent man cannot entirely escape.

With the present habits and propensities of man in general it will require a long period of time before, even in England, one of the most healthy countries, we arrive at the age when "There shall be no more thence an infant of days, nor an old man that hath not filled his days: for the child shall die an hundred years old." The blessings of Salutland are yet a long way off.

Man is greatly, but not entirely, to blame for his short existence here. He ought to be taught to reflect and see in his own mind and conscience that he does not live his proper span, and that it is very greatly his own fault, and that he cannot too soon amend his ways.

Every man and woman is so occupied and absorbed in his or her own pursuits that both confess to "having no time" to attend to sanitary science—there are men appointed for the purpose and whose time is occupied as health officers and inspectors, let them attend to sanitation! This is a great mistake, every man and woman is bound to acquire sufficient sanitary lore to enable them to decide whether their house is in a healthy state or not.

The sanitary authorities everywhere ought especially to be thoroughly posted up in sanitary matters, and should not allow of the existence within their spheres of any fever dens or overcrowded houses; no unpaved or undrained streets, no improperly drained houses, or houses undrained, no dirty streets or alleys, no foul air or clouds of noxious smoke, no bad food, drink, or medicine, and no bad water should be allowed.

It is, as has been already said, the purpose and object of this Congress to stir us all up, for we are all—governed and governors, to blame for the prevalent shortness of human life, and for the existence of preventible diseases which destroy so many before their allotted span of life has been fulfilled.

To these Congresses of the Sanitary Institute and the other agencies engaged in sanitary work, we look for better health and longer life for our people.

Let us indulge the hope that, when this Congress shall have been dissolved, and shall have left us all the instruction it has had in its power and kindness to impart, a new departure in sanitary science and practice will be taken by our worthy authorities, and that the city of Newcastle-upon-Tyne may in future years be as celebrated for its salubrity and the health and longevity of Novocastrians as the town was in times, now long past, remarkable for standing low in the scale of health.

May the new city act up, under sanitary auspices, to the old town's motto, *Fortiter Defendit Triumphans*, and be as triumphant over disease as in ancient times the old town was in its defence against its northern human foes—foes, happily now, no longer!

Captain Douglas Galton, C.B., said he rose to request the Section to give a hearty vote of thanks to Dr. Embleton for his most interesting address, and he did so confident that all present would feel that full justice had been done to the subject which Dr. Embleton had taken up. No doubt the question as to the length of life was one which all would like to be solved, and would wish it could be solved in the way Dr. Embleton had suggested in the latter part of his address. He was sure that they would feel, with Dr. Embleton, however, that the accidents, which always occurred in life, and the difficulties of our modes of life, would most likely prevent any of them ever attaining that very great old age which had been so temptingly held out as a prospect to them. He thought, in the face of the large amount of work the Section had before it, that it would be undesirable to detain them longer, and he would, therefore, only beg that they would give a very hearty vote of thanks to Dr. Embleton.

Mr. G. J. Symons, F.R.S., seconded the motion, and, speaking as a member of the Institute, said that he thought they had been extremely fortunate in finding in Newcastle a gentleman so eminently adapted for presiding over the section as Dr. Embleton. He could not help adding that he should be extremely glad if it were possible that in some way or another the sanitary truths of which they talked so much, and for the promotion of which they were all so anxious, could be brought more to the knowledge of the younger members of the community. In our early days, we learned a great deal about the geography of uninhabited islands, and other equally unimportant matters, but the necessities for the proper conduct of our bodies and our houses were not, in his opinion, sufficiently impressed upon juvenile minds. He had great pleasure in seconding the motion.

The motion was then put to the meeting, and carried unanimously.

Dr. EMBLETON, in reply, thanked the section for the vote they had accorded him, and for the hearty manner in which it had been carried.

On "*Sketch of the Sanitary History of Newcastle-upon-Tyne*," *by* HENRY E. ARMSTRONG, Medical Officer of Health.

BELIEVING that the hygienic records of the different places in which this learned association holds its annual assemblies are likely to have, temporarily at least, a special interest to the members, I have chosen for my theme the sanitary history of Newcastle, in the hope that such information as I have been able to collect may not prove unacceptable to the distinguished visitors who honour us by their presence here to-day.

Except for dismal accounts of plague and pestilence, the past of Newcastle, as with other cities and towns, prior to very modern times, is in many sanitary respects practically prehistoric; the material at command, even to so recent a period as last decade, being meagre in comparison with that available since the passing of the Public Health Act, 1872; and since that date sanitary activity throughout the country has been so general that much of the progress here is but the parallel of what has occurred elsewhere. Our city nevertheless presents many hygienic features worthy of general note. One of these is the characteristic of age—a quality, from a sanitary point of view, not always regarded as honourable. Several times has she changed her name before finally settling down to that by which she has now for 800 years been known. Pons Ælii, Monkchester, and perhaps also Ad Murum—titles she has successively borne before the Norman conquest, carry her back so far into the remote past as almost to justify the statement of an old local worthy that "Newcastle *always was* an ancient town."

At the door of antiquity, and various degrees of time minor to it, lies most of the impediment to the improvement of the health of towns. With cities as with men, the surroundings of birth, infancy and youth mould the growing form and impress on it or develope in it properties, principles and peculiarities characteristic in after life. The circumstances giving rise to the origin, or deciding the site of a town; the nature of its successive populations, their social condition, occupations, and environments; the purposes intended to be served by its various buildings; and last but not least the principles and aims of its different builders, are so many factors, all widely varying in degree in different cases, and each powerful for good or evil on its ultimate hygienic development.

Newcastle is to be considered from such standpoints as these if her sanitary condition at the present day is to be properly appreciated and understood.

It has frequently been observed that the founders of the town had sanitary objects, among others, in view in selecting the site. This may be seen in a glance at the map which I have prepared so as to shew in blue tint the ancient water-courses crossing it. No less than five of these Burns—as they are termed in the north of England and in Scotland (though for what reason I cannot say unless on the principle of *lucus a non lucendo*)—with their tributaries, drain the central half of the city and empty themselves into the Tyne within a length of little over a mile. These are, Skinner Burn, Lorke or Lort Burn, Erick Burn, Pandon Burn, and Ouse Burn. With the exception of the last-named all are now covered in and converted into main sewers, terminating below tidal reach. The principal streets were arranged so as to get the sanitary benefit of these streams: thus Pilgrim Street, one of the oldest, stands on the long ridge of land between the Erick and Lorke Burns, each side of the street draining at its back into a different Burn.

The general aspect of the ground on which Newcastle stands is toward the south, and the surface inclines gradually but steeply to the river. The altitude above sea-level (high water mark) toward the north-west, ranges from 12 feet at the Quay to 355 feet at the Union Workhouse—in a distance of about a mile and a half. The rise from the river to Byker Hill, the highest point at the eastern side of the city, is 180 feet in about three quarters of a mile. There are, therefore, excellent facilities for drainage.

The subsoil consists chiefly of clay with, at intervals, irregular beds of sand containing springs of water near the surface, originally pure, from which the inhabitants at one time drew largely —by means of private wells or public fountains. One only of the latter, supplied with spring water, remains, viz.: that at the entrance to the Leazes, near St. Thomas' Street.

Originally founded by the Romans for the stern purposes of war; afterwards adopted under a different name as the abode of peaceful Saxon monks, with whom in their forty religious houses—in the words of the historian Bourne, "the business of religion went briskly on"; again fortified by Norman Conquerors, surrounded by walls, and crowded with dwellings,—our good old town has known many vicissitudes. In the words of Dr. Bruce, our reverend historian (one of the Vice-Presidents of this Congress). "Many times has the besom of destruction swept over Newcastle. Sometimes in the name of improvement, sometimes in the form of calamity, but most frequently from a love of change, that which our fathers have reared has been removed to make way for our own handiwork." These vicissitudes have not been without effect on the health of the inhabitants from time to time. For example, the huddling together of habitations within the walls, especially in certain localities, was doubtless a great cause of the spread of the pestilence so prevalent here in past ages; and to-day the old and narrow streets of the central districts, insalubrious relics of the past, are a source of continual trouble to the Sanitary Authority.

The records, such as they are, of the state of Newcastle from the building of the Town Wall until 1762, when the first part of it was taken down—the happy Union of England and her hereditary foe rendering them no longer necessary—are full of sanitary import. The Wall, said to have been first built by William Rufus, and afterwards gradually extended, was in 1745, 2 miles and 239 yards in circuit, 8 feet thick, and 12 feet high. Its course, indicated by the red margin on the plan, corresponds pretty nearly to the following modern streets:—Beginning near the Guildhall, it extended down the Quayside to the Milk Market, up Causey Bank, thence crossed the foot of Pandon Bank, turned to the north-west, passed between Trafalgar Street and the Prison, up Croft Street to the Public Library; thence by New Bridge, Blackett and High Friar Streets, round St. Andrew's Church, between Stowell Street and the Fever Hospital, (where the Wall with one of its Towers is still in good condition); it then crossed Westgate Road, passed down Pink Lane, across Neville Street and the Central Station to the Postern, behind and parallel to Orchard Street, across Hanover Street and the Close, to the River.

Of the seven gates of the Wall, one only still stands; and except the portion between the Railway Station and St. Andrew's Church—most of which is in good preservation—very little else of it remains.

The wall enclosed an area of 164 acres. (The area of the city of to-day is 5,371 acres). From the records of the Collection of the Poll Tax in 1377, it appears that Newcastle had then a population of 3,970—being twelfth in the list of principal towns, several now smaller, such as Lincoln, Salisbury, Lynn, Colchester, Beverley, being then larger. This population is at the rate of about 24 persons per acre.

The prosperity of the town in the past has fluctuated considerably. In the year 1400 Newcastle was made a town and county of itself. According to the historian Brand, "Edward 1st appears to have had his mints and to have coined money at Newcastle." A Mint was established here by Henry II. The coal trade of the district was opened out in the reign of Henry III.; and under the first three Edwards, as Dr. Bruce informs us, Newcastle became the principal rendezvous for the vast armaments mustered for expeditions against Scotland;—we have it on the authority of Brand, that Edward VI. "on the dissolution of the Bishoprick of Durham, * * * * proposed to have erected a Bishoprick at Newcastle out of part of the revenues of the dissolved See, but these purposes were defeated by the death of the King." In the latter end of the reign of Queen Elizabeth the duty on coals brought £10,000 a year to the Corporation; in 1622 there were vended by the Society of Hostmen of Newcastle 14,420 tons of coal; and in 1703 the Trinity House of Newcastle informed the House of Commons, "that six hundred ships, one with another, each of eighty Newcastle chaldrons, with four thousand five hundred men were requisite for the "carrying on" of the coal trade. These facts indicate a wealthy condition. But the sun of prosperity did not always shine. At other times the substance of Newcastle was wasted by misfortunes. In the year of the Great Plague we read that "the Corporate funds were reduced to so low an ebb that recourse was had to neighbouring gentry for aid—and loans or gifts thankfully received of sums often so small as ten or five pounds are recorded. The wars with Scotland harrassed the town, and famine pressed her so sore that parents were driven to eat their own offspring.

Whilst the population was having its vital powers severely tested by the social changes to which it was exposed, the condition of the town itself in these, the dark ages of sanitation, must indeed have been deplorable. The evidence on this point, though not much, is strong. There was an almost general absence of domestic "conveniences." Public places were defiled with filth and refuse of every description. By the records of various incorporated companies it appears that trades, offensive and other, were carried on in the open street:—butchers, tripe preparers, &c., habitually threw their refuse into the channel. In 1640 eighteen cartloads of dung had been allowed to accumulate against the walls of the Trinity House Chapel! It is recorded by Bourne in his history of the town, that in the reign of James I., the dunghill within the bounds of the Castle, "had increased to such a size and bigness that it was in length 98 yards, the depth of it was 10 yards, and the breadth of it 32 yards." The weight of this immense mass of refuse (probably about 27,000 tons, or two-thirds of the present annual output of the ash-pits of the city!) had thrown down part of the Castle Wall. The plan attached to the work just quoted shews a "Miding" on the "Key-Side," and there were others in different parts of the town. It is needless to say that in those good old times the indignant ratepayer did not vent his grievances in the newspapers on the subject of his privy neglected by the Scavenger or the noisy Corporation cart,—because, as the song says, "they weren't invented yet."

It is on record, however, that spasmodic attempts were occasionally made for "getting away the muck," as scavenging was then pithily termed. In those days the streets were narrow, but to the credit of the town be it spoken—well paved, and Sir William Brereton in 1639 writes that "in every street he had seen there were the daintiest flagged channels." The houses of former times were commonly built of wood. None of these remain to the present day. *Periunt etiam ruinæ.* A few made of more durable material, and therefore presumably originally intended for habitation by the better classes, remain. Such are the Castle Garth, Pandon, Blythe Neuk, one side of Sandgate—celebrated in local song—now, apart from the matter of mere decay, types of all that is insanitary. The ground was densely packed with such dwellings. The local word "Chare"—so frequent in the old parts of the town—of Saxon derivation, and meaning a narrow winding street, is a proof of this. In the time of Brand (a hundred years ago) there were no less than twenty of these "Chares" from the Butcher Bank, Pandon, &c., leading to the "Key-Side," and several still remain. From opposite windows of the chare you could shake hands—if you wanted. One was appropriately named the "Dark Chare,"—another, still remaining, is the "Pudding Chare." The word "Entry" (probably also local) is very common in old Newcastle, and applies to passages and courts and blind alleys still narrower than chares, and often branching off from them.

Some idea of the magnitude of this sanitary evil may be formed from the Government Report of the Inquiry into the Cholera Outbreak of 1853, where it is stated (p. viii.) that the aggregate length of the narrow lanes and entries of Sandgate "exceeds a mile, while their average breadth at the bottom but rarely exceeds four feet; the upper storeys of the houses, many of which are lofty, often projecting over the lower ones so as to leave at the top nothing but a mere chink or rift for light and air to make their way through."

Water Supply.—The water of the various "burns," by which as we have seen the town is intersected, would not long continue fit for drinking purposes when the population began to increase on their banks. Wells and springs were doubtless the principal sources of supply for centuries. The earliest project for bringing water to the town appears to have been in 1349, but whether the scheme was large or small, and whether ever carried out, is uncertain. There had been, time out of mind, a conduit of water in the Warden's Close (corresponding to the present site of the Fever Hospital and land between it and Oystershell Lane), respecting which Brand quaintly records the simple method adopted 200 years ago to determine the quality—"Certain referees were appointed to take some washers with them to view the water and report." The monasteries frequently had cisterns —one at least of which helped to supply the town. One interesting feature of Old Newcastle at a later date was the "pants," *i.e.*, public drinking fountains and horsetroughs combined. The word "pant" is I believe local, and is probably of Anglo-Saxon origin. In 1693, water for the supply of beerhouses, victualling houses, &c., was pumped from the river near Sandgate. This scheme which, as may be supposed, did not answer, was known as "The Folly." Water was then brought to the pants from a cistern erected at the Castle Leazes Pond. The first project of any magnitude for providing the inhabitants with water was that of Yarnold in 1700, who erected works at the springs near the village of Coxlodge. This supply, sufficient in Winter was defective in Summer, and was afterwards for some time supplemented by water drawn from the river by the "Folly" works before mentioned, and by other water brought on horses and in carts, and from various springs in the neighbourhood.

We have now traced the water supply of Newcastle up to the time of the first removal of part of the town wall, and will there leave it for the present. Meanwhile let us turn to the subject of the prevalent diseases by which the population of Newcastle was afflicted in its mural period.

In the absence of any regular system of registration of sickness or mortality it may be assumed that, of the epidemic outbreaks among the inhabitants, the severe ones only have been put on record; it may also be taken for granted that of the accounts of these, some are doubtless erroneous from over—and others from under—estimation of magnitude. All such outbreaks are confounded under the common terms "Plague" and "Pestilence." Two great epidemics are known to have occurred in Newcastle during the 13th century, of which one lasted three years; in the 14th century there were three, one occurring about the time of the "Black Death," and continuing two years: two epidemics are recorded as having occurred in the 15th century, and six in the 16th; in one of these (A.D. 1579) 2,000 persons were carried off between May and Michaelmas, and ships were warned by the authorities against coming to the port as usual for coal. Ten years later the mortality attained similar proportions, and still nearer the close of the century the town suffered from a visitation of plague of three years duration. In the 17th century there were no less than eleven epidemics, including the Great Plague of Newcastle in 1636, in which about 7,000 persons are said to have died in a population of probably less than 20,000.

The town at this time is described by a writer of the period as having become almost desolate, the streets grown green with grass, her treasury wasted, and her trade departed.

Preventive Measures.—If, in these days of Sanitary legislation, Sanitary Science and Sanitary Congresses, we should be inclined to pride ourselves, as we are apt to do, on our advancement and superiority over our predecessors as regards the prevention of the spread of infection, let us first inquire what preventive measures our predecessors really did adopt.

It may be a salutary lesson to learn that in all or most of our boasted methods of stamping out disease—the Novocastrians centuries ago have been beforehand with us. We read that the sick poor were sent out of the town and encamped on the waste ground without the walls; that others who did not leave their houses had their doors sparred up, and their food provided at the cost of the town, hoisted up to them by the Corporate Officers; that huts for the sick were provided at Arthur's Hill, and in the Warden's Close; that in some cases chapels and other buildings were utilised for this purpose; that sick nurses were engaged; that there were officers termed "Clensors," and others appointed to fumigate infected places, &c., with pitch, resin, frankincense, and vinegar; that officers were appointed having the duty of killing with a flail all stray poultry, dogs, and swine in the view that they aided in conveying contagion; that suspected ships were visited; that sweet scented herbs were strewn about; that the expense of burials was borne by the town; that in time of sickness new comers into the town were warned by the bellman "to avoide;" that the Barber-Chirurgeons held meetings on the outbreak of disease, and were in fact a Board of Health; and that in the latter half of the 17th century there was a public officer named the "Town's Physician," the prototype of the modern Medical Officer of Health. It was well said, "There is nothing new under the Sun!"

Nineteen years after the first part of the walls were taken down, that is to say in 1781, there were, according to Mackenzie the historian, 2,389 houses in Newcastle, inhabited by a population estimated at about 30,000, or an average rate of above twelve persons to a house, and about 183 to an acre—numbers decidedly high compared with those of the present day (probably about 7·5 persons to a house, and 27·5 to an acre of the entire city, including the Moor and Leases, or 36 persons to an acre excluding these large open spaces).

The Plan of the Town at the time shews that about one-third of the ground within the walls was unbuilt on. Much of this ground, now covered with dwellings—many of them of no very high character for sanitary qualities—then consisted of meadows, gardens and pleasant places, one of which, Pandon Dean, was so delightful as to give rise to the following verses, published in the *Newcastle Weekly Magazine* in 1777 :—

PANDON DEAN.

When cooling zephyrs wanton play,
Then oft in Pandon Dean I stray;
When sore depressed with grief and woe,
Then from a busy world I go;
My mind is calm and soul serene
Beneath the bank in Pandon Dean.
The feathered race around me sing,
They make the hills and valleys ring;
My sorrow flies, my grief is gone,
I warble with the tuneful throng;
All, all things wear a pleasing mien
Beneath the bank in Pandon Dean.
* * * * *
Above me stand the towering trees,
And here I feel the gentle breeze;
The water flows by chance around,
And green enamels all the ground,
Which gives new splendour to the scene,
And adds a grace to Pandon Dean.
* * * * *

The young lady who penned those lines little thought that in the course of a century this lovely spot would be the subject of my official representation under the Artizans and Labourers Dwellings Act, at the Local Government Inquiry into which the following unpoetical evidence was given. The *New Pandon Group* (built on the sides and bottom of what was formerly Pandon Dean) "consists of 239 tenement dwellings, occupied at the time of inspection (Nov., 1875) by 958 persons; of these dwellings no less than 179 consist of one room, 57 of two rooms, and three only of three rooms each * * * Including the streetway the group covers 1·66 acres, and is populated at the rate of 646 persons per acre * * * The Group is much enclosed on every side * * * *."

Then follows a detailed description of such a mass of defects in the New Pandon Group as plainly to account for its death-rate of 47·7 per 1,000, and to justify the conclusion that from sanitary and building imperfections, from sickness and mortality, situation and surroundings, it was the very worst of the tenemented property of Newcastle.

The hollow in which the New Pandon Group stood a few years ago is now filled up.

The year in which the foregoing verses saw the light (1777) witnessed also the foundation of the Newcastle Dispensary, the second institution of the kind in the provinces. In the annual reports of this institution appeared the first systematic returns of the sickness of the Borough. These returns shew the extent to which diseases prevailed among the working classes. In a review of the statistics of the Dispensary during one hundred years, published in 1877 by the then Medical Officer, Dr. Monteith, it appears that in the first twenty-five years of the institution, "fever" was greatly on the increase, 786 cases having been admitted during the first quinquenniad of the period, and in the last 1,143. During the first four years of the present century the "fever" cases in the Dispensary averaged 370 per annum, the population of the town being a little over 28,000. The wretched sanitary condition of the habitations of the poor at that time may be gathered from the following quotations from a pamphlet published in 1804 by "A Member of the College of Surgeons." The writer says: "It is impossible to give a proper representation of the wretched state of many of the habitations of the indigent, situated in the confined lanes from the Quay-side, Castle Garth, and Sandgate, which are kept in a most filthy state, and, to a stranger, would appear inimical to the existence of human beings; where each small unventilated apartment of the house contains a family, with lodgers, in number from five to seven, and seldom more than two beds for the whole.

"The want of convenient offices in the neighbourhood is attended with many very unpleasant circumstances, as it induces the lazy inmates to make use of the chamber utensils, which are suffered to remain in the most offensive state for several days, and are then emptied out of the windows; the consequence of which may be readily conceived."

The pamphlet goes on to say:—

"The writer, a short time ago, had occasion to visit a soldier ill of the fever: his lodgings were in the garret of a miserable house situated in the very filthiest part of the Castle Garth. It was divided into six small apartments, and occupied by different families, to the number of twenty-six persons in all. The garret contained three very wretched beds, with two persons sleeping in each. It measured about twelve feet in length and seven in breadth, and its greatest height would not admit of a person to stand erect; it received light from a small window, the sash of which was fixed; two of the number lay ill of the fever, and the rest appeared afraid of admission of pure air, having carefully closed up the broken panes of glass with plugs of old linen. The garret on the opposite side was occupied by a woman and her five children." At this time the prevalence of fever in Newcastle extended to the better classes, and gave rise to most alarming reports, as the following passage from the same pamphlet shows:—

"'*The bad fever*' was talked of in all the coffee-houses in London; post letters underwent fumigation; intercourse with the town was considered dangerous; many travellers left Newcastle out in their journey; and others, in confidence of some charm, ventured to gallop through the town, highly perfumed with camphor, musk, and frankincense. The rumours even reached the Baltic, and ships from the port of Newcastle were obliged to perform quarantine."

This spread of febrile contagious diseases in the homes of the poor led to the foundation of the "Institution for the Prevention and Cure of Contagious Fever," which was opened in the year 1804.

During the second quarter of a century of Dispensary life the admissions from fever were comparatively few (2,812); but in the third there was a very large increase (7,141), extending, more or less, over the whole period, but most marked during the eleven years ended 1848, when the yearly average was 401 cases.

A seven years lull was followed by a term of six years (ending 1862) yielding each an average of 232 cases of fever. From that date until the centenary of the institution fever has decreased in prevalence, so that during the past ten years the average yearly admissions were a little over 106, as compared with 370 at the beginning of the century, when the population of Newcastle was only one-fifth what it is now.

The pamphlet already quoted shews that of all diseases liable to fluctuation, "fever" has been the most prevalent. The statistics of these diseases are summarised in order as follows:—

NEWCASTLE DISPENSARY.—Admissions and deaths during one hundred years, ended A.D. 1877:—

	Admissions.	Deaths.
"Fever"	18,084	833
Diarrhœa	13,033	469
"Consumption"	10,616	3,492
Scarlet fever	6,665	725
Measles	4,730	244
Whooping cough	2,924	398
Small-pox	2,616	428
Cholera	928	155

It should be observed that the mortality of "fever" to admissions is misleading, since a large proportion of the cases were afterwards removed to hospital. The admissions under the head of "consumption" are in reality an overstatement, each "admission" representing a fresh Dispensary letter presented by the patient, who requires several of these in the course of a lingering disease.

Fever in the course of a century has been, according to the foregoing statistics, twenty times as prevalent as Cholera. The former has never been entirely absent, the latter has appeared only as a very rare visitant. And yet there are persons of intelligence and endowed with education, who fail to grasp the importance of, and need of provision against, the former, whilst the mere mention of the latter is enough to fill them with dread. Time after time during the past hundred years has our poorer population been ravaged by epidemic after epidemic of typhus, but the general public is content to have things as they are; and there are some among us who seek to maintain that Newcastle with its 150,000 inhabitants has sufficient accommodation for infectious diseases in the venerable old Fever Hospital, erected when the population was about one-fifth of what it is at present, and that all epidemics may be met by other "resources of science!"

About forty years ago began what may be termed the dawn of sanitation in Great Britain. The country then awoke to the necessity of permanent measures of public hygiene in lieu of the spasmodic efforts formerly made only during the immediate influence of panic.

Sanitary Associations began to spring up, and Royal Commissions were instituted to look after the health of towns, one of which towns was Newcastle. An able report by Dr. D. B. Reid, one of Her Majesty's Commissioners (and including other reports by the Chairmen of Local Committees expressly formed to assist Dr. Reid's inquiry, among whom were Mr. Thos. Sopwith and Mr. Thomas Dunn, formerly Mayor, Chairman of the Cleansing and Nuisance Committee of the Corporation), was published in 1845. This report gives an exhaustive account of the hygiene of Newcastle and other places at the time. We gather from it that there were then thirty-three streets in the town, many of them very old, without drains or sewers; that there were no regulations for street formation; that the new streets were planned in such a desultory manner as to prevent proper drains being made; that builders were under no restrictions as to drains; that the open sewers and ditches were very offensive; that the parts of the town beyond the limits of the ancient parliamentary borough were in an extremely neglected state; that many new streets were unpaved and dangerous; that such private drains as existed in houses of the middle and higher classes were generally defective and offensive; that the dwellings of the poor were very deficient in all conveniences and necessaries; that there were no regulations for cleansing courts and alleys; that there were large public refuse depôts in objectionable places; that there were many nuisances against which the inhabitants had no remedy except by indictment; that the authorities had no control over the refuse of ashpits, &c., unless complained of as a nuisance; that among the poorer classes, offensive refuse was deposited in lanes and vacant corners; that many old dwellings situated in narrow ill-ventilated courts, occupied by the poorer classes, and built against the sides of steep hills, were constantly damp and unhealthy, seldom with water introduced, and overcrowded.

The same report gives a list of the streets then considered most injurious to health, many of which are to-day in fair sanitary condition, though many others, it must be admitted, are now in even a worse state than then. This very interesting report, which contains also a special one on the water supply, terminates with an account of the open spaces of the town, coupled with the earnest recommendation "that additional pieces of land be obtained and set apart for the public use for ever, both at the eastern and western extremities of the town." How this excellent advice has, after the lapse of some thirty years, been acted on to the full, will be afterwards shown.

A few years after the issue of this report, the town was visited by the severest epidemic of Asiatic cholera on record.

It is not improbable that some of the early visitations of "pestilence" may have been Asiatic cholera. The only outbreaks of that disease, described as such, in Newcastle are three in number. The first occurred in 1831-2, causing 1,039 cases and 322 deaths; the second, in 1848-9, is described as having been "light and mild;" the third, in 1853, caused 1,533 deaths in about nine weeks. The last, and by far the greatest, was, it cannot be denied, to a considerable extent due to the insanitary condition of things as above described. There was, however, another important factor, to which we will now turn, clearly and intimately associated with the course of this epidemic.

We have traced the water supply till toward the close of last century. As it continued unsatisfactory, the Common Council in 1770 granted a long lease of a piece of ground on the Town Moor for a reservoir for water from Coxlodge. This was soon afterwards augmented by a supply brought into the town by aqueduct from Spring Gardens, and we learn from a pamphlet published by the late secretary of the present water company, that in 1805 additional water was obtained by the then water company by sinking a shaft in a field near the north end of the Moor; and from these different sources the town was served for about twenty-five years on the intermittent system, the water being laid on three days a week. In 1831 (the cholera year) the supply ran out. In the extremity water was pumped from the river and distributed in carts.

In the following year an opposition water company obtained an Act to supply the town; and in the competition which ensued the old company finally succumbed. The surviving company drew water from the Tyne at Elswick, filtered it, and pumped it up to a reservoir at Arthur's Hill, whence it was delivered to the inhabitants by gravitation. This river water gave rise to great disatisfaction, and led to the projection of a newer company, who went so far as to get an Act of Parliament in 1840, but did nothing more. The former water company, to meet increasing demands, sought for legal power to pump from the river at a higher point (Newburn), but were unsuccessful.

From the Report of the Health of Towns Commission in 1845, by Dr. Reid—already quoted—it appears that at this time the water was principally drawn from the river. Other sources of supply were a spring at Carr's Hill (Gateshead); the spring at Coxlodge, aided by day water from an old pit-working; drainage and surface-water of the Town Moor; wells in private houses; rain-water from roofs, &c. The Corporation had erected standpipes or fountains, always open to the public, in different parts of the town, viz., one each in Gallowgate, Percy

Street, Darn Crook (now, the more's the pity, modernized into St. Andrew's Street), High Friar Street, Newgate Street, Bigg Market, High Bridge, Head of the Side,* Westgate Street (known as the Vicar's pump), foot of Pilgrim Street, Manor Street, Sandgate (West and East), St. Ann's Row, East Ballast Hills, St. Lawrence, the New Green Market, and the Leazes, and one was in course of erection in the Close at the date of the report. The Company's water was supplied to the tenants on three days of the week. The poor paid one farthing for a tub or large pailful—four or five times the charge to tenants.

Soon after the issue of the Health of Towns Report, the "Whittle Dean Water Company" came into existence, with the laudable object of providing a constant service from water collected and stored a dozen miles or more from the town. Their works were completed in 1848, and included reservoirs capable of holding 215,000,000 gallons, or what was considered a ten months' supply. By 1850 the number of consumers had increased beyond previous calculations, and the reservoirs were found to be able to hold enough water for six months only, instead of ten. To make matters worse, that year was one of drought, and the supply ran short. The company then began to pump from the Tyne, amid loud complaints from the inhabitants. After this they increased the capacity of the reservoirs by one-half the former amount, extended their gathering grounds, and took means to draw, if found necessary, from the small river Pont, in the neighbourhood of the reservoirs. But they also extended their range of supply down the river. This last named extension began in May, 1853. Within six weeks afterwards there was a water famine: the Tyne was resorted to: Cholera followed.

Whatever may be urged in defence of the water supply in relation to this outbreak (as, *e.g.*, that river-water had on former occasions been consumed by the inhabitants without ill effect), it cannot but be admitted that there was a remarkable coincidence, as appears by the evidence given, between the turning off of the Tyne portion of it and the decline of the epidemic. After the experience of 1853 the company went further afield for water, and since then have again increased their gathering grounds and means of storage. They still retain the power of drawing from the river, and have two pumping stations (one at Wylam and the other at Newburn), but state that in the event of having ever again to recur to that source, they will do so for

* Apropos of this quaint old local name, a friend once remarkd to me that people often talked of the side of the head, but never until he came to Newcastle, had he heard any one speak of the "Head of the Side."

manufacturing purposes only, with which object they laid a special line of pipes about four years ago.

Our present water supply is good in quality; it is filtered before delivery, and is always at full pressure. The reservoirs are capable of holding 1,827 million gallons, and on the 6th of the present month (Sept. 1882) contained 1,120 million gallons, or about one hundred days' supply.

By the Newcastle Improvement Act 1865 the Corporation obtained various important sanitary powers, which since that time have not been allowed to lie dormant.

Two years after the passing of the Act, several important sanitary reports were presented to the Town Council. From one of these—the work of a committee under the presidency of Ald. Wilson, the chairman of the present Sanitary Committee—it is evident that energetic action was then taken to put in force the different provisions obtained for the protection of the public health. Thus—under the powers enabling the Corporation to raise in advance the moneys required for paving, sewerage, &c.—a large number of previously defective streets were put in good order; the sanitary staff was permanently increased, active steps were taken to prevent overcrowding; upwards of 500 unhealthy dwellings were closed in less than two years, and to meet the difficulty of the persons removed from their homes, rooms were provided elsewhere by the Committee; about a tenth of the most unhealthy of the dwellings before mentioned were purchased and pulled down; a temporary hospital, in anticipation of cholera was erected on the Town Moor, and a disused Chapel in Forster Street, fitted up with beds for the same purpose was soon afterwards successfully employed for the reception of cases of scarlet fever. A large special staff was also organized and engaged for a considerable period under the extensive provisions of the Sanitary Act of 1866, the town being divided into districts for the purpose. The ashpits, previously cleansed at the expense of the owners, were now cleansed out of the rates; vigorous measures were taken to purify tenement and other property, &c., &c.

The report shews that at that time upwards of 23,000 rooms, representing the dwellings of 55,060 persons, or half the population, were inspected—of which one-eighth were found to be without the means of good ventilation; the same proportion were without water, one-fifth were without privy accommodation; two-thirds only of the houses had good drainage, and one-eighth had none at all; nearly 8,000 persons lived in rooms yielding less than 300 cubic feet per person. The Committee, among other conclusions, expressed their conviction that for the cure of many of the sanitary evils of habitations of the lower classes, one remedy only would be effectual, namely, the provision of other accommodation, the opening out of thoroughfares and the demolition of habitations incapable of being put into proper sanitary condition. This opinion was given eight years before the passing of the Artizans and Labourers' Dwellings Act of 1875 —of which it is the foreshadow.

At the time of the report referred to the annual death-rate of Newcastle was 32·3 per 1,000. It has since fallen gradually to 21·7 last year.

Five years after this saw the birth of the Public Health Act of 1872, and in the following year Newcastle, in common with other Urban and Rural Districts throughout the country, had a Medical Officer of Health. Of the doings of this functionary it becomes not me to speak. The proceedings, since his appointment, for the improvement of the dwellings of the poor, the prevention of disease and the sanitary benefit of the inhabitants in general—are they not written in his nine Annual Reports?

Among matters of importance in relation to the hygienic condition of Newcastle of to-day, not the least is the amount of recreation ground open to the public. Including the Town Moor and Leazes (lands in grass, but not laid out ornamentally) and the Armstrong, Brandling, Elswick, and Leazes ornamental Parks—the exercise ground to which the inhabitants have right of free access comprises a total area of 1,268 acres, being almost one-fourth of the entire city, and at the rate of one acre to every 114 persons, an amount probably unequalled in any other large city or town. (These spaces are shewn coloured green on the plan accompanying my later Annual Reports.)

An official representation under the Artizans and Labourers' Dwellings Improvement Act, 1875, was made to the Corporation as the Local Authority in 1876. The areas specified in the representation were those of the New and Old Pandon Groups —the former of which has already been referred to. In support of this representation, the Sanitary Committee recommended the purchase of the property of the New Pandon Group, at a cost of £26,000, for demolition of the houses thereon and the erection of new dwellings elsewhere. The buildings were ultimately acquired and demolished under the provisions of a local Act, and as already stated the hollow in which they stood is now filled up. A large proportion of the property in the Old Pandon Group has also been dealt with under the same power.

Since the passing of the Newcastle-upon-Tyne Improvement Act, 1865, the cost of the different sanitary works executed by the borough engineer has amounted to upwards of half a million sterling, and included the following:—*

Sewering†	£74,583
Flagging and paving	172,370
Street watering	14,349
Scavenging	102,839
Ashpit cleansing	104,460
Other sanitary works	52,895
Total	£521,496

The powers with respect to the notification of infectious disease and other sanitary matters—acquired by the Corporation under the Improvement Act of the present year—are fresh in the memory of this association.

The necessity for the provision of a new sanitary hospital to meet the requirements of this populous city, in place of our ancient fever house, has for years been strongly represented by the Sanitary Committee, and, in the abstract, is pretty generally admitted by all. But the mere indication of a *site* for such a purpose—and many sites have, one after the other, been proposed—has invariably met with very great opposition.

The foregoing very imperfect sketch, though in many respects an exhibition of the dark side of the picture, as is, alas! too often unavoidable in treating of the sanitation of the past, shows the magnitude and difficulty of the task bequeathed to the sanitary authority, and the willingness with which they have addressed themselves to it. The reduction of the yearly death-rate per 1,000 of the population by ten in as many years, and the diminution of typhus in the same time to one-fifth its prevalence in the corresponding period immediately before, are tangible results of their more than herculean labours.

Mr. T. P. Barkas moved a vote of thanks to Mr. H. E. Armstrong, and said he did so with very great pleasure, because the paper had brought before them a great number of interesting facts in relation to Newcastle. Mr. Armstrong had referred to a pernicious midden in Sandgate about 100 years ago, but he might have told them that up to a few years ago there were a great number of similar middens.

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* From information kindly supplied by the City Engineer, Mr. W. George Laws.

† The construction of mains (other than in new streets) and maintenance of public sewers.

Owing to the activity of the sanitary engineer the contents of these middens were removed from each house daily, and this, he contended, was a step in the right direction. He agreed with the reader of the paper as to the very excellent supply of water the inhabitants of Newcastle had at the present time. The quantity was good, and the quality, he had heard from the medical officer, was good also. There was one matter to which the reader of the paper had not called attention, and that was with regard to the wells they had in Newcastle some twenty or thirty years since. There were very few houses at that time which had not got wells. He had had a well in his own house, but it was now filled up. The sewage of the town now reached the water of the wells which thus became undrinkable, and he was glad to say that they were now supplied with very good water by the Water Company. Mr. Armstrong alluded to a very extensive report in 1868, when the mortality went up to 33 or 34 per thousand, —a very serious and a steady mortality—and he had said that at that time very great interest was taken in the sanitary condition of the town. That report was certainly one of the most exhaustive reports —he would not say ever written, but ever submitted to the inhabitants of the town of Newcastle-on-Tyne. Mr. Armstrong had also referred to a very important question,—namely, the establishment of a hospital for the treatment of patients suffering from infectious diseases. There had been, he might say, a very considerable diversity of opinion in the Town Council upon that subject. Some members were not very desirous of having a hospital. Mr. Armstrong and the Chairman of the Sanitary Committee were, however, with others, very anxious to spend a considerable sum of money in erecting a new hospital. However, the whole matter would come up for re-consideration, and he trusted that whatever was to be done—whether the hospital were to remain at Bath Lane, or go elsewhere—the better course would be adopted by the Corporation. He said he had great pleasure in moving that the thanks of the meeting should be given to Mr. Armstrong for his paper, and he trusted that it would be the means of inaugurating a general movement in the direction of sanitary reform in Newcastle-on-Tyne.

Mr. W. S. Daglish (Town Clerk of Jarrow), seconded the motion, remarking upon the compulsory notification of infectious diseases, he said, he thought that if this were necessary in one part of the country it was necessary in another. If it were necessary in any particular part of England, he could not see why it was to be neglected in Newcastle. He said he could not see, with reference to the Artizans' Dwellings Act, that the Corporation of Newcastle had taken any steps at all in the matter, and he thought that when so much had been done in the town, this matter should not have been neglected. The Corporation, in his opinion, ought to have erected artizans' dwellings when they pulled down so many houses in Pandon. They were very glad to hear that the death-rate was low, for this was a very satisfactory matter. He had great pleasure in seconding the motion.

Captain DOUGLAS GALTON, R.E., C.B., F.R.S., said, he certainly thought that members of the Sanitary Congress who were strangers in the town of Newcastle, and who wished to see very good models for reports of towns, should certainly look at Mr. H. E. Armstrong's reports, as they were most exhaustive and interesting in every particular. He did not know whether the compulsory isolation of diseases would be brought before the Congress that day, although it was not actually in the proceedings of that Section. It was one of the burning questions of the day, and it would be very interesting, he thought, if members would, upon this paper of Mr. H. E. Armstrong's, address themselves somewhat to that question. There was no doubt that in the bad dwellings in which the poorer classes lived, it was of the utmost importance in cases of infectious disease, that those who were suffering should be removed from these close dwellings; but they could not, of course, make a law which was to be observed only by one class, and, therefore, amongst those persons who had more accomodation in their houses, and who would willingly devote themselves to the duty of nursing the sick members of their family, very great opposition would arise if people were to be compulsorily moved from their homes when suffering from infectious disease. At the same time, he thought it was one of those questions which must come before Parliament sooner or later, and it would be as well to get the opinions of various members of the Sanitary Institute upon it.

Professor F. DE CHAUMONT, M.D., F.R.S., remarked that he should like to say a few words upon the paper they had heard read. The return of admissions and deaths in the Newcastle Dispensary which Mr. H. E. Armstrong had put before the Section should receive the attention of all persons who were interested in Sanitary Science. The numbers, perhaps, did not seem to be very large, but if they bore in mind the varying population and the large numbers reached at the present time, the number was very considerable. But what was more important to discuss, was the proportion between the number of deaths and the number of patients admitted. He had just taken out the proportions with regard to the mortality, and in the course of a few remarks, he referred to the enormous amount of deaths from consumption, which he said was a disease unfortunately too prevalent in this country. The death rate was enormous; for the proportion of deaths to admissions was 1 in 3, and he was afraid that many of those who were discharged died afterwards of the disease. The figures which were represented on the map before them showed that 1 in 22 died of fever; of diarrhœa, 1 in 28; consumption, 1 in 3; scarlet fever, 1 in 9; measles, 1 in 20; hooping-cough, 1 in 7½, or 2 in 15; small-pox, 1 in 6; and cholera, 1 in 6. These figures bore out what he had remarked about consumption, and he remarked that people were too apt to come to the conclusion that consumption could not be avoided, and must be endured. He did not think that medical men should look at the matter from that point of view, but that they should try to do all they could to prevent the disease. He was of opinion that a plentiful supply of pure air and good food would certainly diminish this terrible disease. It was quite true that when consumption had been established in a family, a certain tendency to the disease probably always existed in the members of the family, and if circumstances arose, which were favourable to the development of the disease, no doubt it would soon show itself. The same, however, must be said with regard to other diseases, and when the doctor knew that the disease existed in the mother, it was his duty to try and prevent its existence in the child. They had a striking proof, last year, of what the President had said in his address, that certain sanitary measures diminished, if it did not abolish, this disease.

Touching upon the question of Artizans' Dwellings, he said it was extremely hard that a labouring man should have his house pulled down, and his goods turned out, and then no other place provided for him. If bad houses were simply pulled down, the inhabitants turned out, and no other habitations provided, those who did this simply left the people to go to neighbouring districts to increase the population there, and to increase also misery there, in precisely the same manner as they had done in the place they had just left. With regard to compulsory vaccination, he said the amount of mortality, from small-pox, had lately become very great, and the death-rate high. He had no doubt, he said, that the disease would disappear altogether from our midst if vaccination became thoroughly general. There were very strong proofs, of the efficacy of vaccination, to be produced. In the first place he would point out that in the German Army, where vaccination and re-vaccination were compulsory, no cases of small-pox occurred, and the disease was absolutely unknown. On the other hand, the French Army during 1870–1, where re-vaccination was impossible at the time, and when many, probably, had not even been vaccinated in childhood, small-pox had been most disastrous. Coming to our own Army, where every man was vaccinated, small-pox never occurred, or cases were very exceptional indeed. He thought that these facts were sufficiently pregnant for his purpose, which was to show that, by the use of proper vaccination, all over the country, the disease might be completely stamped out. As to the notification of disease, he said that one difficult question, and one which was always started, was who was to give the notification? Some urged that both the householder and the medical man should give the notice (as is the case in Holland), while on the other hand it was argued that it was hardly necessary for the medical man to do it, and that all that was necessary was for him to communicate with the householder, and warn him, as to his duty, to give the notice. He concluded by heartily supporting the motion for the vote of thanks.

Mr. E. C. Robins, F.S.A., said the great advantage of the law for the notification of infectious diseases would be the great degree of isolation which would be obtained as a necessary consequence of the announcement. He referred to a statement which he had heard made that people were allowed to visit their friends, who were patients with infectious diseases, in public hospitals, and he urged that this should not be allowed, and that great care should be taken in this matter.

Dr. Sergeant expressed his satisfaction at being able to see the results of one hundred years' work of the Infirmary. In his town (Bolton) it was stated that the mortality they had had in every disease had been excessively great. He thought that the real truth was that they only had the worst cases reported, and he believed that a very large proportion of the fever cases which occurred in his town were privately treated at their own homes. In his opinion, direct notification from the medical attendant was the only efficient system. He thought that if the information were voluntary it would not be satisfactory, for many cases of infectious disease endangering the public safety would never be notified, and, moreover, the medical attendant might be placed in a more awkward position than if the responsibility rested on the householder as well. If the certificate of the medical man had to be sent to the sanitary authority through the householder, delay might be caused, and the certificate would run more chance of being destroyed or lost. The public did not object to the notification of infectious disease so much as the medical profession. To his knowledge medical assistance had in no case been delayed from fear of notification. He concluded by expressing his pleasure at the paper which they had just heard, and which was extremely valuable and instructive.

Mr. Daglish remarked that compulsory notification was found to work well in Jarrow, and there had been no complaint.

It was suggested, in a further short discussion, that the report to which reference had been made should be supplied to the Members of the Congress.

The motion for the vote of thanks was then put and carried.

Mr. H. E. Armstrong, M.R.C.S., in replying, expressed his obligations for the kind remarks which had been made with reference to his paper. It was not very exhaustive, and, had time allowed, he could have given much more information in it. As to the establishment of a permanent fever hospital, the authorities had done their best to find a site; but the difficulties they had met with seemed almost insurmountable; they had recently been obliged to begin to build a temporary hospital. With regard to other points which had been raised during the discussion, he said he thought that as a general rule public law must depend upon private experience. Notification of infectious diseases would be of little value if the medical man was not bound to notify. He thanked them for the vote they had passed.

"*The Sanitary Aspect of Dress*," *by* ALFRED CARPENTER, M.D., S.Sc., Vice-Chairman of the Council.

THE field which rightly belongs to the Sanitary Institute embraces everything which has reference to the house we live in as well as its surroundings. This field should be surveyed in its social as well as its sanitary aspect, and includes a consideration of our clothing, as well as of the bricks and mortar in which we live. The conditions which belong to the "*corpus*," vile though it may be considered by some, are necessarily a part of sanitary work, the surroundings of that "*corpus*" must not be limited to the material house or the municipal conditions under which its inhabitants and their fellows are lodged. Muncipal laws are made binding by Act of Parliament, and laws which are called sanitary, having received the assent of the Queen and of the Lords and Commons, are or ought to be rigorously carried out by those whose duty it is to see to their proper observance.

But there is a field in which the Queen has comparatively little power, and Parliament none at all, but in which the Sanitary Institute may fairly lay claim to some authority, and should undoubtedly attempt to exert it. If Parliament were to rule that chimney-pot hats should not be worn, and if it enacted that their wearers should go to prison for that offence against parliamentary law, the prisons at present in operation in this country would be totally insufficient to contain those who would suffer martyrdom rather than give up the use of the tall hat. In their heart they would not care a jot for chimney-pots, but for Parliament to declare them illegal would be subversive of all freedom of action, and Britons would be pleased to go to prison in defence of the use of chimney-pots rather than submit to the serfdom which is indicated in the refusal of the liberty to wear anything they choose, however insanitary or however contrary to the lines or beauty. If the Crown were to be of opinion that tall hats might be worn, in opposition to the views of Parliament, there would be a return to the days which followed Cromwell, or to the condition which held when a red or a white rose was a telling symbol. Fortunately such days are gone by, and the liberty of the subject is secure in all those matters on which opinions may differ, provided that such liberty is not enjoyed to the injury of our neighbour's health or property. I have said that even the Queen has little power in the matter of clothing, though fashion is supposed to emanate from the Court. There is a power which is greater than even that of the Court, and that is society, and the fashion which is outside Court influence.

and which permeates all classes. So long as society tolerates and fashion encourages tall hats, the institution will flourish and the custom of wearing them continue; but some day the chimney-pot will disappear even from the Preparatory School at Brighton, where it is still looked upon as indicating the march of intellect, and separating the *men* of those particular schools from those of an inferior rank. It is considered snobbish not to wear a tall hat at a Brighton preparatory school, and the so-called men at those schools are very particular on this point, a part of the subject which I wish to bring to the notice of the Sanitary Institute, viz., the subject of dress. Sumptuary laws cannot now be enacted by Parliament, because the age has become too sensible to interfere in such matters, but they exist in our schools. The Eton boy's jacket and the Stock Exchange dress are prescribed by custom, and none dare depart from the rule of the house, though that rule is unwritten. Custom and fashion may be insanitary, but their votaries do not know it, and there is no school to teach them what is sanitary or insanitary as regards dress, except the common sense which the rulers of fashion too often ignore.

Why should not the Sanitary Institute have a word to say about it, and try to influence public opinion, and through public opinion society and fashion, against some of the barbarous customs which still continue to flourish amongst us, and to bear fruit in a thousand different ways, producing an immense amount of disease and misery among those who are scarcely aware of the mischief they have brought upon themselves or caused other people to suffer? I ask the attention of the Congress to a few points upon which it is necessary to speak out in a way which may catch the attention of the sensible among us, and so help to diminish the evils which folly and fashion are ever ready to foist upon us, teaching their votaries that discomfort and uneasiness have only to be endured for a season for them to become evidences of the *Beautiful*, even if they diminish the privileges of the *useful*.

But was ever term so missapplied as that of the Beautiful in dress? Can anything be more hideous than some of the customs which fashion introduces among us? I should like to see the Council organise an exhibition of the hideous articles which fashion seems to compel people to wear, and even to consider becoming. A cultivation of right principles of beauty belongs to the region of art rather than sanitary science; but they meet on the confines of dress, and I commend this meeting-point to the attention of our cousins of the Social Science Association as one which they may very well cultivate in connection with art.

I will especially direct attention to the *foot*. Let anyone examine a few dozen feet, let us say, of the first hundred persons who may be met with upon the pavements of Newcastle, or of any other large town, and what shall we find? not one half of that number will have natural feet. The toes will be twisted out of shape in some way or other, certainly not in any way which can be said to be beautiful, which term may be truly applied to a well-formed foot. If the shoes are looked at it will be seen that they are distorted likewise. If the feet are those of young children, the cause of this distortion is not far to seek. Parents are forgetful of the fact that children's feet have a tendency to grow larger, and when people get boots for their children's feet this growth is not provided for. The boot-maker is expected to make the boot fit the foot as it is, not as it will be two or three months hence. The result of this custom is that the foot is cramped in its new home, and is not allowed to grow in its proper direction; the muscles are pressed upon, they cannot develope aright, and, as a result, there is wasting of flesh, loss of muscular power, and distortion of toes, which, when adult life is reached, produce the misshapen feet now so common, and so little thought of among those who are victims to this mistake. They hobble along in anything but a graceful and easy manner, but they do as others do, and that is enough. This error is not limited to the rich and well-to-do. The feet of the poor are treated quite as badly, for the boot-maker fits the foot, or rather forces the foot to fit the boot, as if the feet were intended to grow to the shape of the boot, and not *vice versâ*. It is inconvenient even to make any difference in the form for either foot, and the difference in shape of right and left is too often ignored. The poor little thing is compelled to bear the forced imprisonment of the flesh and bone until the foot is kneaded into shape, and made to fit the article which the parent has purchased. It would be far better for children to be brought up without wearing any kind of boot at all, than to have the muscles wasted, the bones distorted, and the joints perverted in their action, in the way in which it is the custom to do now, among the high and low, rich and poor. If they never wore boots and shoes at all until they ceased to attend school, it would be very much better for the health and the correctness of the shape of the foot, as well as the fleetness of the owner, whilst it would be a great gain to the poor themselves in the way of expense. It may be said that such a course is impossible in this changeable climate. I contend that it is not; that it is the custom in many parts of the United Kingdom colder and more bleak than our English towns, and that it is only a question of habit, not of necessity, which leads to the use of shoes and stockings at all for children; for those who do not wear such things are like sailors who never trouble about them.

But what shall I say of high heels and pointed toes, as worn by the lady who aspires to be considered as "a queen of society," who wishes to make a sensation among her fellows? Surely it argues a low taste—a very weakness of intellect—among our fashionable ladies, that such a thing is possible.

The injury which the health receives from high heels and pointed toes must be great. If our girls would be natural, if they would develope their muscles as nature intended, high heels and pointed toes would be impossibilities. Fortunately lawn tennis has done something to prevent the complete triumph of high heels, for tennis shoes allow full play to the foot, if the wearer intends to play the game as if she desired to win it. Lawn tennis players, and the lovers of cricket and football, if they wish to distinguish themselves must give the muscles and joints of the foot full play or they will certainly be beaten by others who have been brought up more sensibly on this point. High heels and pointed toes must interfere with exercise, must make the wearers suffer from want of muscular exertion, and therefore lay the foundation for all those diseases which spring from dyspepsia and its allies. The foot must have full play for the use of its numerous muscles, and for the proper action of its joints, as well as room to grow. Who can count the evils which spring from tight boots, the mischief which corns have produced in the world, the miseries which have resulted from the harsh words caused by the blister or the bunion. Many a duel has been fought in consequence; perhaps the irritability produced by the tight boot has led to bloodshed on a larger scale, whilst the number of marriages which would have taken place but for this cause is beyond calculation, and all because a foot has been ligatured.

It is this tendency to ligature other parts of the body as well as the foot which so often renders human nature ridiculous, and sets up suffering of the most serious kind. The good sense of the English matron is banishing stays from the list of articles which young girls wear, but they are sadly too much used, even now. Health is sacrificed to figure, the viscera of the body are displaced in the most extraordinary manner from the position which they should occupy, because it is thought by some that a "slim waist is a thing of beauty." Look at the wasp, it is thin, but it stings, and the man who marries a wife with such a waist will probably be stung in more ways than one, for wasted muscles and distorted viscera will produce that acidity of temper which destroys the comfort of a home, and makes a household the centre of discord, instead of that peace and happiness which should be the desire of every domesticated Englishman and woman. There are a great many points connected with my subject which might be considered. A whole session could be devoted to it, if it were canvassed in all its aspects. Consider the way in which our infants are clothed and ligatured to their fatal injury, the materials in which they are enveloped, too thin in cold weather, too thick and heavy in hot seasons, impervious to moisture when they ought to be ventilating, making the body perspire at the wrong time and in the wrong way. Then again the nature of the materials we put on could be discussed, their relative capacity to retain warmth, and keep out cold, their endurance under wear and tear, and above all the manner in which they retain the germs of infectious disease, and the way in which such germs could be destroyed without injuring the texture of the clothing. There are also the different ways in which health is affected by the mode of manufacture. Textile fabrics are loaded with poisonous articles, for the sake of appearance. Health is sacrificed to gain. The maker as well as the wearer is damaged, too often without the source of damage being suspected. The use of arsenic, antimony, and lead as colouring materials, or for the purpose of rendering the article heavy in the weighing scales, and the manner in which linens are dressed for the market, and woollens made to appear what they are not, are subjects of great importance to the health of the community. The neglect of the laws of morality, of the lines of true beauty, and of correct sanitary principles in the matter of dress is sufficient to justify my short paper, and to give me a reason for calling the attention of the Congress to some of the causes of continued ill health among the community. That which Parliament dare not do, and which the Queen and her Court are unable to effect, will not be produced by the Sanitary Institute; but, though Parliament has ceased to enact sumptuary laws, because real knowledge and good sense are opposed to such enactments, the Sanitary Institute, by promulgating sound information upon the matters in question, may influence public opinion, and assist in bringing good sense into power, even among the votaries of fashion and the followers of custom. This may in time effect the object desired, even more certainly than could be done by Queen, Lords, and Commons combined, or by compulsion in any form.

Alderman Wilson proposed a vote of thanks to Dr. Carpenter for the paper, and to Mr. Symons for reading it.

Mr. E. C. Robins, F.S.A., seconded the motion.

Captain Douglas Galton, C.B., said that most of them knew instances of very great evils which resulted from high-heeled boots. He had tried to induce the members of his own family to give up high heels, and he could only say it was absolutely impossible to get a young lady to wear anything which was not in fashion. He was afraid that even were the Sanitary Institute to hold a congress upon the subject they would scarcely be able to convince the people.

The motion was agreed to.

Mr. G. J. Symons, F.R.S., in acknowledging the vote of thanks, said that the writer of the paper commenced by condemning the chimney-pot hats. The members of the section must not be led away to blame only ladies for wearing high-heeled boots. It would be easy to prove that a chimney-pot hat was a bad thing, and he would like to throw his chimney-pot hat overboard altogether, but custom would not allow it. He remarked that it was rather hard to single out the ladies for blame, and not say a word about gentlemen's boots, which were open to all the objections mentioned by Dr. Carpenter. Great benefit would result if they could get common sense introduced in connection with their clothing.

"*Influence on Sanitary Progress which medical men might exercise in their private practice*," *by* R. T. Hildyard, Captain late Royal Engineers, Engineering Inspector Local Government Board.

I shall begin what I have to say with the assumption, which is, I fear, not likely to be disputed, that the advance in sanitation has not been as rapid as might have been hoped. Though large works have been carried out by some sanitary authorities, still the public at large, including all classes—the educated and the uneducated—show great apathy in sanitary questions, and do not, as individuals, take those steps which are necessary to insure to them in their own homes the benefits they should derive from the large public works carried out. Old houses are left as they are; and there are daily springing up new ones built in defiance of all the simple rules which now receive universal assent. We have this Sanitary Institute doing a great work: we have sanitary associations, sanitary engineers, sanitary journals, sanitary legislation,—and yet sanitation makes but slow progress. Apparently, there is no excuse for ignorance or for indifference; but yet the fact remains, that 999 persons out of a 1,000 go into a new house without any sufficient guarantee that it is a healthy one. It has been pretty generally admitted that it is no use thinking of legislating people into sanitation; and it seems that, unless we can infuse some new life into the work, we shall soon have to come to the conclusion that it is no use offering people facilities for voluntary action. The horse may be brought to the water: in this case, indeed, the water has been brought to the horse; but the public declines to drink.

Much good has, doubtless, been done by the great sanitary movement which has been going on of late years, but that good has been done among the professional men dealing with sanitary matters. Architects, engineers, surveyors—thoroughly conversant with all the details of house sanitation—are forth-coming, and vast improvements have been made in the manufacture of the various details; but unfortunately this progress only touches the skirts of the difficulty.

If the great stupid public were impressed with the importance of sound advice and sound work, if all houses were built under the supervision of an architect, we should have good grounds for congratulation. But it is not so. The vast majority of houses are built by speculative builders, who know nothing and care as little for sanitary matters, who set all laws of health at defiance, and constantly from sheer ignorance put in inferior fittings when superior ones could be had at a less cost. The only check on this evil must be a demand for improvement, coming from the public, from those who are to occupy the houses. As yet this public has not been touched. It appears that men of science, reformers, professional men, may strive in vain, unless they can reach some key which has not yet been tried. The men of science are too scientific, they shoot over people's heads; the reformer is too enthusiastic, his condemnation is so sweeping that people feel safety in numbers; professional men are open to the accusation of self-interestedness.

There is nothing attractive in the subject; indeed, many of its details are naturally repulsive. And here I would touch on what has been, I would submit, a mistake in the sanitary movement generally. This Institute has specially devoted itself to the elevation of the professional classes, but it has been a common theory that every man should look after his own house.

There are two great objections to this: first, that it is contrary to the natural instincts of our present stage of civilisation; and, secondly, because the householder cannot possibly be so well fitted for the task as those properly trained to the work. I once complimented a drainer on the neatness of some spade work he was doing. "Eh, sir," he said, fondly patting the side of the dyke with his spade, "I think a well cut drain be the most beautiful of all God's works." This principle, which in other words, is that of taking an interest in the task to which it has pleased God to call a man, is really at the bottom of all good work, and we can hardly expect to find it in an amateur. The only reason for this suggestion of superseding the professional man is, that in the past he has failed to rise to the requirements of his position. But on this account to throw the whole responsibility on the householder is about as wise as to recommend him to undertake the doctoring of his family. Let the householder by all means feel the importance of having his house in proper order, but this should lead him not to try amateur plumbing, but to employ the best skilled assistance he can find. If there is a demand for good thorough work, it will soon be forthcoming according to the common economical law of supply and demand.

But whatever view we may hold on this point, there is evidently required some powerful influence to start the whole train of machinery: and I believe there exists such an influence which has not up to the present been brought into full play. I allude to the medical man in his private capacity, not as a reformer, as a legislator, or as a man of abstract science, but as the familiar family doctor. In the former rôles, medical men have fully taken the prominent place which might be expected. In the latter rôle, I do not believe they have exerted the full influence of which they are capable, and it is in this rôle that they appear to offer the very factor we are in want of.

Here we have a scientific man, the natural successor of the present, ephemeral class of reformers: a man, whose study in life is the improvement of the health of the community: a man who bridges over the gap between abstract science and its application to the details of life: a man who is daily gaining practical experience of the conditions in which families actually live, and who is continually turning on these conditions the new rays of light diffused by pure science: he is, too, something far more than a scientific man, he is brought more than any other man, in daily contact with his fellow-men: it is a part of his daily work to study the feelings, even the idiosyncrasies of his patients. Ailments are often influenced as much by mental as by physical conditions, and a medical man to be successful must obtain a moral influence over his patients. Here, then, is the very man to have weight. Again, the family doctor is essentially our friend in time of sickness, when we are nervous as to ourselves, or about those we love; when we are peculiarly open to advice—we all know the old proverb: "the devil was ill a saint the devil would be; the devil was well but devil a saint was he." The doctor is on the spot, ready to strike just when the iron is hot; and people are not likely to treat his warnings lightly. Nothing perhaps shows better the power medical men exercise than the sufferings people with small incomes constantly go through at their bidding. A child is sick; it is ordered to the sea. The father's work is in some big inland town: he cannot leave it. The difficulties in the way appears insuperable, but still the doctor looks grave: the home is broken up; the father shifts for himself; the mother with a string of children of ages various, drags off with a heavy heart, but yet the sick child gets sea air, and benefits, or not, as the case may be. It may, perhaps, be said that the doctor in one case can give a definite opinion, while in the other he can only speak on a general suspicion.

This, to some extent, may be true; but, on the other hand, has a doctor any right to give a decided opinion as to the benefits of change of air, if he is ignorant whether the air his patient breathes, or the air he orders him to, is contaminated or not? It is not enough to say, "Really, we must be allowed to assume that people can take some care of themselves." There is no more reason for allowing the assumption in this case than in the case of diet or exercise. It would be very undesirable that the doctor should be turned into a sanitary engineer; we do not wish him to lay down the law as to what is to be done, or to force people to any considerable outlay; all that is necessary is that, where he is not satisfied that a house is safe, he should force people to get a sound opinion on the matter, There can be little difficulty in a doctor, a scientific man, arriving at a reasonable suspicion in such matters; and it cannot be too strongly urged that it is one of his first duties to do so. In these days, when physic is so rapidly giving ground before attention to diet and surroundings, the purity of air and water must hold a place of increased importance. If a patient were questioned, as to the absence of danger in these essentials to health, as carefully as he is as to his diet, the doctor would be able to form as definite an opinion in the one case as in the other, provided always that it be accepted as a dictum that it is the duty of a householder to know, either of his own knowledge or on competent authority, that his air and water are, as far as human foresight can make them, free from danger. Ignorance on this point should be taken as sufficient to show the necessity for investigation. In some cases, no doubt, doctors will find their advice unpalatable; but so are their physics and their dietaries; and, if the importance of pure air and pure water be consistently urged, there is no reason to suppose that doctors will lose influence with their patients. Till now, I have been speaking of cases where doctors are called in, and have, from the symptoms of the case, no special cause to suspect the presence of impure air or water. Often, however, the symptoms do point directly to the presumption that these are the source of the evil, or, at least, an aggravating factor in the case. Here, for a medical man to prescribe for the particular ailment, and merely to suggest that it would be well to have sanitary arrangements looked to, is a positive waste of his powers for good. People do not act on a mere suggestion of this sort, any more than they would act on a mere suggestion that they should break up their homes and go for change of air. If the medical man feels the importance of sanitary arrangements, he must impress it also on his patients. To cure the symptoms, and yet leave the deep-seated cause untouched, is like re-papering a damp wall. It may be thought that I am speaking platitudes —probably, as regards most of those present, I am doing so— but I urge further action on the part of medical men, because, in the course of a wandering life about the country, I have become very strongly impressed with the fact that there is room for it.

The other day I looked over a high-class London house, and found every sanitary arrangement defective; indeed, the sewage was merely soaking away through the soil beneath the basement. In that house there had just been a case of bad throat, turning to erysipelas; yet two doctors attending the patient had drawn no particular attention to sanitary matters. I have lately seen a good deal of our South Coast watering places, the health resorts to which invalids are ordered by London doctors, with a recommendation as to the resident doctor they had better consult—places where people are, as it were, met by the doctor on their arrival.

Yet in house after house it is the old story: water-closets and drinking water connected; open channels for sewer gas by cistern overflows, sinks and baths, unsafe traps, damp walls, and damp basements. Surely if medical men used the undoubted influence they possess, and insisted on people paying attention to such matters, things would be very different. Let a doctor say, "I cannot be responsible for the consequences if you persist in neglecting my advice as to these sanitary arrangements," and the indifference to the public must soon disappear. Again, doctors are daily consulted as to suitable places of residences: one place is pronounced too bracing, another is too relaxing; but sufficient stress is not laid on the importance of a patient going to a really healthy house. What is the use of a naturally bracing air, if it is fouled by the stupidity of man? What is the advantage of a gravel soil, if it is soaked with sewage? If medical men paid more attention to these matters house-agents' particulars would include something more than the occasional bald statement—drainage and water supply good. If sanitation is not attended to in health resorts, where people are entirely in the hands of the doctors, what can we expect elsewhere? And yet I do not think that any one concerned with the public health should feel satisfied until it is the universal rule that no house should receive fresh tenants without a full and sufficient guarantee that it is in a satisfactory sanitary condition.

Once a house is occupied, the difficulty of remedying matters is vastly increased. The occupier may have a remedy against the owner at common law; but the processes of this law are slow and costly, and its results are not always satisfactory to those who appeal to it. But in these days of constant locomotion and constant change, a vast amount of good would be done if it were only possible to prevent people going into unhealthy houses. Any attempt to effect this must result in some system of reliable certificates or of registration. I will not pretend to enter into the details of any such systems, but will urge, that to command the confidence of the public they must have the sanction of the medical profession; and, that to ensure their general utility, they must also have their active support. It is for medical men to aid the efforts of the sanitary reformers, by associating themselves everywhere throughout the country with these sanitary movements, which are now struggling into existence. There is, perhaps, a natural reluctance on the part of residents, medical men, and others to agitate publicly as to the condition of the place they live in. They are anxious to maintain its good name for healthiness, and any movement they may originate to improve this, is likely to be taken hold of by rivals as a peg for adverse and, perhaps, damaging criticism. This, however, is not a feeling which will bear analysis: it smacks too much of a leaning to the screened existence, rather than to the absence of evil. But I do not even ask medical men to agitate in this manner. Let them encourage, and lend their names to local associations, where they are deserving, as a guarantee to the public, and let them, in the course of their daily practice, do the great work by instilling into their patients the principles and the importance of sanitation. The policy of inaction on the part of residents, is evidently a short-sighted one. The name of a place cannot be kept up for ever, unless it rests on solid grounds; and the best way in the long run, to maintain the character of a place, is to render it worthy of it. Our great watering places have, of late years, spent thousands on systems of main sewerage, in some cases I truly believe, to draw visitors, in the belief that health must be good where such large sums have been spent. But as time goes on, it will prove that these sums have been wasted as regards all those houses, which have not done their part in the great work of sanitary reform.

Sewers are of little or no value unless they are properly used, good water becomes foul if improperly stored, gas vitiates the atmosphere unless ventilation is provided. For the ratepayers to spend large sums on public works, and yet as individuals to do nothing to enable them to profit by those works, is about as stupid as if we were now to be content with the old pack horse, which was in use before McAdam transformed quaggy tracks into our present highways. Individuals as well as public bodies must move with the times.

I will now go one step further, and even ask medical men to trench somewhat on the sphere of the professional sanitarian, whose assistance I have said they should urge on their patients. I look upon the doctor as the friend of the family, and I cannot imagine a more friendly act than helping a family to realise the danger they may be in. There is one simple test which may at once disclose so many hidden dangers, that in my opinion it cannot be too widely known, and it is one which the householder, with a few common sense directions, can carry out for himself. I refer to what is called the peppermint test, which consists merely in pouring an ounce of the pungent oil of peppermint into any one part of a system of house drains, and noting any points where the odour appears to gain entrance into the dwelling. The cost is about 4s., and I have seen it produce more effect than hours of argument. It is not generally known that the most dangerous sewer gases are often inodorous, and the effect of finding the strong fumes of peppermint mounting through the house is most convincing as to the certainty of sewer gases following the same course. I see no reason why a medical man should not put down on a sheet of paper directions as to this or any other simple test he may prefer, just as he would write a prescription, and should not further ask for full information as to the results arrived at. It is not wise to urge that these results should be taken as an actual basis for the work which may be necessary; in practice errors are apt to arise with inexperienced operators, but the test nevertheless is an admirably simple means of arousing a householder from the slumbers of a false security, from a fool's paradise, and of establishing the evident necessity of calling in skilled assistance.

It will be seen that I do not advise an interference with the duties of any other class of professional men. If the medical man gets his patient to try the peppermint or any other test he will in a vast number of cases be practically passing him on to the sanitary engineer, just as he might pass him on to the dentist if he found the case was rather in the province of the latter than in his own. There would be no jealousy, nothing but friendly co-operation which would have very good results for all, and especially for the patient. It may be said that to rely on the medical man, when called in in time of sickness, to arouse people to the importance of sanitary precautions, is to shut the door only when the horse is stolen, but the analogy will not hold good. There are few houses where the doctor does not enter once a year, and if in the course of twelve months, we could get a tenth of the present defects taken in hand, there would be more work than all the plumbers in the kingdom could get through. In conclusion, I will express the hope that medical men will not consider that I am speaking in any unfriendly spirit. There is nothing more marked of late years than the increased attention paid by the profession, to what often appears petty details, and I feel sure that all who have been brought much in contact with them can bear witness to their unwearied kindness in helping those in charge of their patients.

Again, all know the position taken by the profession in the great sanitary movement. If, as I believe, medical men do not exercise the influence they might in sanitary matters, it cannot be from any thought of shirking trouble or from any want of scientific acquaintance with the subject. It would seem that there is at work some subtle influence which escapes ordinary observation, and with which I must leave them to deal.

Captain Douglas Galton, C.B., moved a vote of thanks to the author of the paper, and, in doing so, remarked that he thought, after an experience of twenty-five or thirty years, that medical men had been the originators of all improvements in sanitary matters throughout the country. They might not have devised the various means of effecting them, but they certainly had been the motive power which pushed forward engineers, architects, and surveyors, in the direction of the improvements.

Professor F. de Chaumont, F.R.S., seconded the motion.

Mr. T. P. Barkas contended that architects and engineers were not sufficiently acquainted with the laws of sanitation, or under their authority certain houses would not have been allowed to be erected. Intelligent working men were as well acquainted with the laws of sanitation as some of our scientific men. He advocated popular lectures.

Mr. H. E. Armstrong, M.R.C.S., endorsed the remarks of the last speaker with regard to the value of popular lectures. He said it was very important that the members of the medical profession should be trained in regard to public health; but there was already too much for the medical student to do in the four years of his ordinary curriculum, and to add a little more work would be to place almost the last straw upon the camel's back. In connection with sanitary matters the public did not get the support from medical men which they ought to receive. Forty-six medical men in Newcastle signed a petition against the Newcastle Improvement Bill, without knowing what the Bill actually contained. He had always maintained that the mode of remunerating medical men was wrong; a medical man was now always paid in accordance with the length of time he attends a patient. He believed every average medical man to be a humane man, but he was so paid as if it were his interest to keep patients as long on his books as possible. If the medical man were paid by stipend he would become an aid to the sanitary authority. He urged the importance of medical men being granted a degree after examination in sanitary knowledge.

Mr. Barkas said the compulsory removal clauses were taken out of the Newcastle Improvement Bill, but the notification clauses remained.

Mr. H. E. Armstrong said that at the time the petition was forwarded he believed the medical men did not really know what was in the Bill.

Mr. C. S. Smith urged the necessity of Parliament granting further powers to local bodies in connection with sanitary matters and new buildings.

Mr. S. Dixon and Dr. A. E. Harris also spoke upon the subject.

The vote of thanks was then passed unanimously, and Captain Hildyard briefly replied to the discussion.

"*Arsenic in Domestic Fabrics*," *by* Henry A. Lediard, M.D. Edin., F.R.C.S. Eng., Surgeon to the Cumberland Infirmary, Carlisle.

This subject has engaged the attention of a certain number of medical men and chemists for many years, and the details are so well thrashed out and the facts so well demonstrated and admitted, that it seems almost superfluous to endeavour to add more to what has already been written, but inasmuch as arsenic is still present to an injurious extent in many domestic fabrics, and the general public so little cognizant of it, there can be no apology needed for glancing over on an occasion like the present the work done in past years and thinking over what may be done in the future as a remedy for the evil.

It appears that attention was drawn to this subject in the year 1857, when Dr. Halley proved the presence of arsenic in the atmosphere of a room in which he worked, the walls of which were covered with an arsenical paper; his deductions were, however, questioned by others who failed to confirm what he had observed. It was stated that arsenic was not capable of volatization except at a heat beyond human endurance, and another explanation was sought for, to account for the separation of arsenic from the paper. Dr. Hinds, about the same time, proved his illness to be occasioned in the same manner; since then much evidence has been accumulating, facts as to sickness gathered from medical men, facts from chemists as to the extent of the presence of arsenic in wall-papers, dress materials, &c., &c., and lastly much important evidence has been obtained by Mr. Henry Carr, from those engaged in the manufacture of wall-papers, and others.

The outcry of exaggeration was raised by those who feared perhaps that their interests might be injured by any attempt to check the use of arsenic; but notwithstanding the absence of prohibition it is a fact that less arsenical paper is in use at the present time. Manufacturers of wall-papers have been found to make attractive paper which they guarantee to be free from arsenic, and this is no small gain.

How comes it, I would ask, that other countries have stringent laws in existence against the use of poisonous substances in general, arsenic in particular, in the manufacture of various domestic articles, if the knowledge of their injurious effect did not exist? Mr. Heisch has given a translation of the Swedish restrictions. In Germany still more stringent laws exist. In France, also, the same prohibition is found to hold. It seems strange that England should be slow to recognise the necessity of legislation also. Up to 1871 no facts were before the public proving arsenic to be present apart from a green colour, and at this time arsenic was proved to exist in papers dark brown, buff, white, blue, and various shades of gray, drab, and mauve; these facts, well known to experts, are entirely new, even now, to the general public, who continue to avoid the bright green in some measure, but accept all other papers with confidence. Dr. Bartlett and Mr. Lakeman have pointed out the dangerous nature of the process of dusting on poisonous dry colours by hand, and manufacturers will be found who have, of their own accord, given up the use of such colours, on account of illness amongst their workpeople. Why arsenic has been used has been pointed out by Mr. H. Carr in his little work on poisons in domestic fabrics, and it is a fact of common knowledge that brilliancy and permanency are effects of the use of arsenic in wall-papers; it is even admitted that anyone who could produce a colour similar in brilliancy to arsenite of copper, without arsenic, would make a valuable discovery. To what extent arsenic has been and is used there is abundance of evidence—a firm of paper-stainers having stated that they used thirty tons of emerald green per annum, and have now partially discarded it, and used eleven and a-half tons only. Another firm of chemical manufacturers advise all wall-paper to be sized and varnished to prevent dust; and this, no doubt, would be an excellent method, if it could be proved to be sufficient; and this leads to a brief reference to the manner in which arsenic acts injuriously in a room. Dust was examined by Dr. Alfred Taylor in 1858 and found to be arsenical; there was an unglazed arsenical paper in the room. In this instance the green colour of the paper aroused suspicion. Pettenkofer, when appealed to by Dr. Taylor, stated that the danger arose from mechanical diffusion. In 1873 Mr. Barrett recognised that the colour was easily detached from walls, and that changes of a hygrometric and thermometric nature might affect a porous pigment and render it more easily detached by currents of air. Mr. Abel, 1858, tried to disprove the presence of arsenic in the air of a room with arsenical paper, and put down the poisonous symptoms complained of as accidental. Chemical investigation of the air in rooms covered with arsenical wall-papers has been carried out by Hamberg, of Stockholm, who came to the conclusion that a gaseous arsenical evaporation was going on. The paper had been up twenty-five to thirty years, the walls dry, and the paper, a beautiful light green ground, was arsenical. Since then, experiments have been made which confirm this, by Dr. H. Fleck, of Dresden.

Professors Roscoe and Schoelemmer, moreover, support the observations of Hinds, Halley, and Fleck.

In 1860 Dr. Heisch published an interesting paper on Arsenical Eaters of Styria, and stated that at the Salzburg factory workmen were compelled to become arsenic eaters for self-protection.

The evidence of the injurious effects of arsenic in wall-papers is now recognised beyond doubt by medical men, who have been much puzzled by anomalous diseases which have yielded to removing the patient to a different atmosphere, and have returned again with re-exposure to the infected air. Instances of death having actually occurred are fortunately few, but on the other hand cases recorded where symptoms of poisoning were present are many. At Limehouse, in 1862, four children died from arsenical wall-paper. Dr. Letheby found three grains of arsenic to the square inch of paper. The following year a child aged five died at Plumstead from arsenical wall-paper; it is not stated, however, whether the paper was analysed.

Dr. Hassell's name must not be left out, inasmuch as he wrote, in 1859, on the use of arsenical and lead pigments in coloration of paper hanging and other articles of furniture, dress, and ornament; he pointed out that chromate of lead was as poisonous as arsenite of copper.

It has been frequently stated that it is impossible that arsenic could be injurious seeing that those engaged in the working of it came off unscathed; and I have at hand the letter of a gentleman who says, "my brother had much to do in the manufacture of all sorts of colours, amongst the rest of emerald green, and used many hundred weight, I believe many tons, of arsenic in a year. He was careful and looked well after his men and women, and no fatal case of arsenical or other poisoning ever occurred in the course of fifteen or twenty years; the women could be longer employed than men without any visible effect, and if any such symptom occurred they were removed to other work. The dangerous work was when the colour was in the air. The manufacture where all was wet was without danger, except such as ordinary care could prevent."

The fact that arsenic is used medicinally would carry no proof that in manufactured foods it would be harmless. Although mercury is given internally by mouth in unction and vapour, yet arsenic is employed solely by mouth and as a caustic, never by vapour so as to be taken up by the lungs. It is well known that workmen suffer when peeling off old arsenical papers—a fact I have established upon my own body. In the *Pharmaceutical Journal* for 1849 a case of death is recorded from the fumes of arsenic emitted from a chemical manufactory chimney at Plymouth. Arsenic has, moreover, been shown to be a poison to the vegetable as well as the animal kingdom. It would appear that some of the evils resulting from the introduction of poisons into domestic fabrics may be traced to that distribution of labour so common in the manufacture of almost everything. The raw material is worked in one place, and the subsequent steps towards finish are carried out in various places—for instance, a thread is made at one factory, it is woven at a second, the calico is printed at the third, whilst the colours are obtained elsewhere. The retail dealer, in the majority of cases, knows nothing and cares less about the composition of the goods provided they pass from his hands. So it is with wall-papers; the colours are not known to contain arsenic, although the dealer is quite ready, perhaps, to say that no arsenic is present to his knowledge.

Arsenic is further used in the manufacture of cretonnes, a material of most universal use in the present day. Many aniline colours are still prepared with arsenic, and arsenite of soda is largely used for fixing aluminous and iron mordants in calico printing and dyeing, instead of cowdung. Again, arsenic from its antiseptic properties, is stated to be used in making size. Large quantities of arsenic are used also for the somewhat limited demand in bird-stuffing, and in this last requirement I have often experienced a headache in the galleries of stuffed animals in the British Museum, and believe that an examination of the dust in the cases and upon the cases, or in the bodies of the animals, might prove interesting. In 1880 a report was presented to the Medical Society of London, on arsenical poisoning by means of wall-papers, paints, &c., but the result added little to what was already known; indeed, the poverty of the report might well be pointed at by those who still think that there is much exaggeration in the present outcry against arsenic. There are two reasons which may account for the report being what it was: it is possible that the committee did not allow sufficient time for a return to be made of those to whom the circulars were sent, and secondly, very few medical men will be found able to analyse materials with sufficient care, although the testing is not much more troublesome than the daily examination of the urine so necessary in medical practice. Very few pharmaceutical chemists would be found to allow that they had sufficient time to devote to chemical research apart from their usual business, and thus it happens that the important link has been wanting to connect symptoms of an obscure nature with their real cause. Negative evidence would be of much importance to those who deny the injurious effects of arsenic; for instance, cases might be recorded where persons were sleeping in rooms with highly arsenical wall-papers, and yet being totally unaffected; but even here allowance would have to be made for individual idiocyncrasy.

What then are the symptoms which are most commonly found in persons subject to arsenical influence in rooms? By my own observation I should say that the mucous membranes of the eyes and mouth give early traces of injury, whilst headache seems to be a constant accompaniment. Irritation of the skin is sometimes spoken of, and very often general depression, with lassitude. Mr. Henry Carr gives a variety of cases, carefully observed, and by the kindness of Dr. Bartlett I am enabled to give details of cases not hitherto published.

Case 1.—A lady, not in strong health, but with no disposition towards headache, giddiness, drowsiness, or lack of energy, being, on the contrary, alert and full of mental vigour, became subject to continued lassitude, with a frequent sensation of being about to fall. Dr. Habershon was consulted, and pronounced that the symptoms were not due to derangement of the digestive organs, but might be due to some unknown irritation of the nervous system. These conditions remained, and with but little fluctuation, until the summer-time advanced and the heat reached 80° Faht. in the shade. She suffered from a series of colds, with nasal catarrh, specific irritation of the mucous surfaces of the nostrils, extending throughout the frontal sinuses, and peculiarly irritating the eyes, and in a lesser degree affecting the pharnyx, œsophagus, glottis, and trachia. Towards the end of July Mrs. H. sent me several pairs of silk gloves she had been wearing, stating that all through the hot weather she had generally found her hands in a state of eruption after wearing the gloves in question. The condition of the skin of the hands was a peculiar erithismus, sharply smarting and urticating, without leaving any permanent inflammation after the gloves had been taken off for an hour or so. I suspected, but failed to find arsenic in the colouring matter of the gloves, except in mere traces insufficient to account for the eruption.

I obtained pieces of the wall-paper, carpets, curtains, and various dress fabrics which had been in use. In the carpet and curtains I found the equivalent of 1·38 grains of arsenious acid.

In a sitting-room just furnished before the attack, in the dress fabrics and artificial flowers worn during the same period, the quantity must have been much larger, judging by the heavy traces found in quite small portions; but the gloves, which undoubtedly produced specific poisoning of the skin whenever worn in hot weather, contained, according to the most reliable experiments with Marsh's, and Reinsch's, and Scheele's tests, such varying and minute quantities of arsenic, that for a time I could not attribute the injury of the hands to this poison.

Just after seeing the lady restored to health by the care taken to prevent the presence of arsenical pigments in house and clothing, I had a visit from a friend, who brought me to test some silk socks which had been worn on circuit by an eminent Queen's Counsel, with the result of his being laid up with a large irregular ulcer in the foot, painful to a degree, and so persistent against all curative means employed by Dr. James Duncan. Both physician and patient were impressed with the conviction that the socks must have been coloured with arsenical dye, although a portion of each of the dozen pairs of socks had been tested by a learned professor of chemistry of high standing, who reported that the socks contained no arsenic, nor any other poisonous matter. My own tests of portions of these socks gave the same unsatisfactory results as had been yielded by the gloves in the former case, and I was about to conclude that the assumption of arsenical poisoning in both instances, however well connected with the wearing of gloves and socks, which gave only such very small quantities of arsenic on analysis, could not be satisfactorily maintained, and that to bring forward such evidence would only cast discredit upon others in which the more palpable presence of arsenic had occasioned less injury, and therefore I did not feel justified in publishing the particulars, however interesting.

The doubt would probably have remained unsolved until now if a committee to enquire into the subject of arsenical poisoning had not been formed by the Medical Society of London, and another for the same purpose by the Society of Arts, composed of such men as Dr. John Simon, Dr. Swaine Taylor, Dr. de Chaumont, Dr. Corfield, and others.

The first step taken was to instruct Mr. Heisch and myself to undertake a series of experiments to formulate a reliable method of quantitively estimating the presence of very small proportions of arsenic in wall-papers, dress fabrics, &c. More than eighteen months' hard work not only enabled us to estimate within half a thousandth of a grain of arsenious acid in any kind of wall-paper, dress stuff, or silken material, but to be able to show it under the microscope in its true octahedral crystals. Tested by the means which we have communicated in the first instance to the Society of Arts, the socks and gloves, previously tested with almost negative results, are proved to contain distinct and definite but not large quantities of arsenic, and the connection between the wearing of arsenical socks and gloves and the skin poisoning is now as clearly proved in these instances as any *ex post facto* evidence of any other poisonous injury by connection.

Colour being no test of the presence of arsenic in many cases, chemical analysis must be resorted to in order to demonstrate beyond doubt whether or no such and such a material does contain this poison; and it is not a little remarkable that Marsh's test, which dates from 1836, should still be considered of the first importance. Reinsch's test (1843) is no less valuable. There are also others: one given by Dr. Letheby in 1846, founded on the discoveries of Marsh, Lassaigne, Soubeiran, Reinsch, and others. And one of the most important questions respecting the presence of arsenic in domestic fabrics is that of a chemical test. The determination of a test which shall admit of the presence of minute traces, such as would come under the head of accidental or unavoidable contamination —quantities too small to produce injurious effects, but which shall effectually exclude all colours where combinations of arsenic are essential ingredients, and where the quantities of arsenic are such as to be objectionable. The consideration of a standard test has engaged the attention of a Committee of the Society of Arts for some time, but their report is not yet published.

The two methods most applicable are Reinsch's, Marsh's, or a modification of Marsh's process. Reinsch's is the most simple, and the best adapted for those who are not expert chemists: it consists in boiling a certain sized piece of paper in dilute hydrochloric acid with a small piece of pure copper foil inserted. If arsenic be present the copper will be coated by a steel or black colour; this coating, however, may be produced by sulphur, mercury, or some few other ingredients of colouring matter. In order to determine definitely whether the coating be arsenic or not, it is requisite to sublime the coppers in a reduction tube, a small thin glass tube about 3 inches in length and $\frac{1}{4}$ inch, or rather less, in diameter. If the copper be cut up, placed in the bottom of the reduction tube, and a spirit lamp applied, the tube being held horizontally, or nearly so, the arsenic, if present, will be driven off from the copper at the heated end, and will form a ring of minute octahedral crystals on the cooler part. If these crystals be obtained, the material tested is unquestionably arsenical. Messrs. Griffin & Sons, of Garrick Street, London, have been requested to supply the apparatus requisite for this process, which can now be obtained from them for a few shillings, together with full instructions for its use. A small lens, or, better still, a microscope, is requisite, by means of which to examine the crystals. There are some few cases, it is true, where the arsenic is not discovered by Reinsch's process; these cases, however, are so few, as not to interfere with the practical working of the test. The indisputable fact is that, if Reinsch's test were generally applied, the use of arsenical colours must inevitably be abandoned by paper stainers.

Marsh's method is founded on the principle of the great affinity of hydrogen for arsenic. If this gas be formed of dilute hydrochloric acid and zinc, in contact with the arsenical materials to be tested, arseniuretted hydrogen is given off; this is decomposed again by passing through a tube in a Bunson burner, and the arsenic is deposited as a dark brown or black mirror, which may be sublimed, and the crystals obtained as beforementioned for Reinsch's process. The arseniuretted hydrogen gas being, however, a most deadly poison, renders this test unsuitable for the general public. Chemists themselves being by no means free from danger in using it. For testing for arsenic, whatever process be adopted, it is essential that the materials used be perfectly pure. The ordinary copper and zinc of commerce frequently contain arsenic to such an extent as would render a test unreliable. Hydrochloric acid may also be impure; a blank experiment should, therefore, always be made; that is, the process should be gone through without the insertion of any material to be tested. If there be indications of arsenic, it evidently must arise from the impure chemicals. If, on the other hand, the blank experiment gives no indication of arsenic, but when some certain wall-paper, or other article, be added, arsenic is found, it is clear that the arsenic is derived from the article to be tested.

The result of the long series of experiments made by the chemists on the Committee of the Society of Arts, will soon be published, and will give some valuable information. It has been said that the investigation made by the chemists in question is not needed. Professional chemists do not need the information, and the general public who are not chemists could not make use of it. Such assertions, however, are utterly mistaken. A good standard test is required by professional chemists, in order that all may work to the same guage of purity—allowing accidental and unimportant contamination, but rejecting all decidedly arsenical materials. If there be no common standard, different chemists will adopt different processes, and different degrees of impurity as the amount to be allowed. As regards the assertion that the general public could not make use of Reinsch's test, the best thing to be done is to let those of ordinary intelligence try it, and defend themselves from poisonous materials. Those who do not feel themselves to be fairly intelligent had better apply to some friend who is, or to a professional chemist.

In order to test the value of Reinsch's process, one hundred wall-papers were procured in a manner to secure having a good general sample of different manufacturers. The result was that all those papers which blackened the coppers thoroughly were found to be arsenical, and gave ample crystals when sublimed. Those which did not blacken the coppers in a complete manner were further tested by the modification of Marsh's process, and were proved to be non-arsenical by both tests. Reinch's test may therefore be considered reliable for all practical purposes, though a professional chemist might hesitate to give evidence that a paper was free from arsenic unless he had tried it by Marsh's process also.

If the chemicals be pure the production of octahedral crystals by any process is positive proof of the presence of arsenic, though in some few cases the failure to obtain crystals by Reinsch's process may not prove the absence of arsenic; however, in the 100 cases above mentioned there was no failure, and every paper which coated the copper eventually proved to be arsenical.

Mr. Henry Carr has, in his little work on "Poisons in Domestic Fabrics," collected valuable information and epitomised it from a manufacturing point of view, and I fail to gather from what appears there, that there would be much difficulty in avoiding the use of arsenic in manufactures entirely. Some paper manufacturers have already given up the use of arsenic, and seem as able to compete as before; others state that a prohibition would be a matter of indifference to them; others that legislative inquiry would be satisfactory. Again, it is stated that as long as the present feeling exists a non-arsenical paper manufacturer would be at a positive advantage. Although firms may be found who would undertake or do undertake to make paper free from arsenic, there is no doubt that great care would have to be taken, both by themselves and the public to search for arsenic. The question of cost has also been entered upon, and the evidence forthcoming seems to show that this would soon right itself, inasmuch as the cost of the colouring matter is small compared with the cost of the entire paper; moreover, it is stated that prohibition would not involve any considerable outlay, except in this respect, that there would be loss upon the manufactured paper in stock.

Lastly, has any case been made out for legislative interference? I cannot help thinking that each year more and more evidence has been forthcoming in proportion to the greater attention that has been bestowed upon the subject, and to the quickened interest taken in it by the public.

So well has the subject of pure water and efficient drainage been ventilated, that dangers to health above ground such as are produced by poisons in various manufactured foods for domestic use, can only claim and will receive a like attention. Some amongst those interested in this subject object to the further interference of the liberty of the subject, by the imposition of additional laws to prohibit the use of arsenic and other poisons in domestic fabrics, but I would hold strongly that laws are good, if only to appeal to in cases of real necessity. In this country legislation has generally and will generally be the outcome of a public cry for it, and those who are in power for the time are bound to lend an ear to a complaint when backed up by sufficient evidence, and by men of unquestioned reputation.

Much work, I think, still requires to be done in systematically examining all and every kind of material of wearing apparel or fabric used in house decoration, for it will be found that arsenic is present in many things apart from wall papers, which have performed the useful task of first calling attention to this important subject.

Mr. C. S. SMITH proposed a vote of thanks to Dr. Lediard for the paper he had read.

Dr. SARGEANT seconded the motion.

Professor STEVENSON MACADAM, referring to the subject of the paper, said he did not think that appealing to the colour-makers, or even the exposure of coloured paper hangings, as in the Section room, would do any good. The moment they spoke to colour-makers and paper-stainers about arsenic, they said it produced a cheap and bright colour, and pleased the eye, and the difficulty was to get something as cheap, which would effectually fill its place. He thought there should be some stringent legal enactment passed upon this matter, such as they had in France and Germany, which would render it impossible for our merchants to sell wholesale quantities of poisonous material.

The resolution was then carried.

"*Infantile Mortality—some of its Preventable Causes,*" *by* ALFRED E. HARRIS, Medical Officer of Health, Sunderland.

A LARGE and beautiful ship moves majestically before a steady wind up the English Channel. All sails are set, and so unconscious of danger are those on board that all her ports are open, and she looks, as she really is, a thing of beauty. The hum of happy voices may be heard everywhere on her decks, for her gallant crew are looking eagerly forward to the evening, when they hope to be once more in the midst of their friends, or in the bosom of their families. But suddenly there is a terrific squall, accompanied with a blinding sleet, which hides the ship from the gazers on shore, who, when the sun breaks out, and they look seaward again, can see no ship, for she, with her brave men, has gone to a watery grave. All England laments her hardy sons, and our grief is made more bitter when we are told the ship might have been saved *if* her ports had been closed, for they would have given her sufficient stability to resist the fierce blast.

An express train is approaching a station at which it does not usually stop, and the engine driver, looking at the signals, thinks he reads that the line is clear. But he is in error; and the train, with its living freight, dashes with dreadful momentum into another standing at the station. There is a terrific crash, and in a moment numbers of our fellow creatures are killed or maimed. And again the country laments their sad fate, and again we are told, to add to our sorrow, it might have been otherwise, *if* the driver had made quite certain there was an open line.

A pitman is working in the coal mine, his lamp does not burn brightly, and he removes the gauze cover to trim the wick. The light ignites the gas accumulated in the pit, and in a moment there is a terrible explosion, and many, many families are left fatherless; and the public are shocked, and their feelings are still farther harrowed by the knowledge that it might have been far different *if* only that man had done his duty by obeying the colliery regulations respecting naked lights. Oh, that saddest of all sad words "*if!*" It has in these instances made us hear with tenfold anguish the gurgling of the waters over the stately ship; the crash of the express train, and the explosion in the pit.

And yet around us on every hand, throughout the length and breadth of this fair land, thousands of human beings die every year, and we do not see their piteous, beseeching, little faces, nor hear their supplicating feeble cries, and they die, and dying attract little attention, save among the very few, although they too might have been saved were it not for an "*if*," the "if" of the twin demons, ignorance and neglect.

The general public do not seem alive to the amount of infantile suffering or mortality which surrounds them on every hand. Few persons of high position give that attention to the subject that the pressing necessity of the case requires. I have therefore chosen this subject more with a hope that it may attract the sympathies of the people of this city and the neighbouring populous towns, rather than with a view of throwing any new light on it.

Charles Dickens more than once in his speeches and writings pictured in burning words, as he alone knew how to do, the sufferings of infants on their journey to premature graves. Unfortunately all our great intellects do not think as he did, but we hear them speak and write of these infant deaths in terms of implied thankfulness. And I have heard men, professing our common Christianity, express themselves in similar strains. This may be the feeling of the political economist, but it is certainly not the view which the members of such an Institute as this should allow to be put forward without protest.

Alas, for such feelings and such sayings! In my opinion, it were a thousand times preferable to inculcate into the minds of the people the baneful teachings of a Besant and a Bradlaugh, than that they, having had children, should be taught that "only the fittest survive," or that "the country is over populated." Once let these ideas become rooted in the minds of the people, and I fear they will become inducements to parents to neglect their progeny.

I cannot believe that an Almighty hand ever sent these little ones into this world, that having lived in it an hour, a week, a month, a year, they should gain an eternity. Surely He never intended that these new spokes in the wheel of life should be injured or fall out through being rolled over rough and broken ground that it was never meant they should travel over.

Some people say,. "Children must die—you can't prevent them." Many, I know, must; it is impossible, or nearly so, to preserve the children of weakly or diseased parents. But, on the other hand, let us recollect the lesson to be derived from the village of Harbottle, in this County, where, at all events up to 1877, and I have no later record, no child had died for twenty years; and where among the families of a farmer and his three shepherds, having between them forty-seven children, no child had died for thirty years. Such facts as these irresistably point to the conclusion that much of the infantile mortality is an unnecessary evil.

Statistics.—The figures of infantile mortality are deserving our closest attention. In the decade 1870–1880, there died no less than 1,278,326 infants under twelve months old; or, expressing it graphically, about as many infants perished as there are inhabitants in Northumberland, Durham, Cumberland, and Westmorland.

In the sixteen years 1838–1854, the death-rate was 165 per 1,000 infants born, but during part of this period—viz., 1841 1845, inclusive—the rate was as low as 147 per 1,000, which is the lowest rate registered in this country.

From 1850 to 1870 the average infant mortality rate was 154 per 1,000, and during the period 1870–1880, inclusive, the rate was as high as 158 per 1,000, while last year, in the twenty large towns, the rate was 152 per 1,000.

The average death-rate in Dr. Farr's healthy districts is only 103 per 1,000 infants born alive. With a rate such as this universally existing there would be a saving of 44,000 lives in a year; or, in other words, sufficient lives would be saved to people a town the size of Southampton, and in ten years 440,000 lives, or a population greater than that of Northumberland; or, in twenty years, 880,000, or as many lives as there are people in Kent.

But it is in the large towns that the greatest mortality prevails, and the rate of some of them—*e.g.*, Leicester—reaches to 200 per 1,000. To understand the effect of these rates on the general mortality of a town, I will take the case of Sunderland and Newcastle last year.

In the former town the annual rate from all causes and at all ages was 20·9 per 1,000 inhabitants, and by deducting the deaths of infants under a year, and the deaths of old people 60 years and upwards, and whose lives at this time are at the best uncertain, I find the mortality of the population is reduced to 12·1 per 1,000, and in Newcastle to 12·7.

Improper Clothing.—A few words now as to the causes of all these deaths.

Perhaps there is nothing that is so difficult to persuade a woman, be she of high or low degree, to do, than to dress her child in a manner which is not only sensible but conducive to the health and well-being of her offspring.

Examine the ordinary infantile dress. It is low in the neck—the better to promote chest complaints. It is short in the sleeves—the better to chill the blood coursing through the arms. It is long in the skirt—the better to cripple the legs and to deny them that free play that strengthens them, and prepares them for the future support of the body. The ribbons on the short sleeves, the lace on the low neck, and the embroidery on the long skirt fill the mother with

"Soft visions of serene delight"

in the prospect of outshining some one else's baby, or perhaps with the better motive of making the child attractive to the father's eyes.

Dresses like these are evils quite sufficient to be borne with patiently in the house, but when used out of doors they demand the severest reprehension. We cannot walk down any back street, in any weather, without seeing mothers on all sides with their "bairns" in their arms, standing at their doors gossipping with their neighbours and exposing the child at once to the cold atmosphere, and to the draught of the doorway.

But as a rule, strong and hale though the mothers may be, we will not see them trifling with their own bodies. They wear no low dresses, and no short sleeves, for they know that such dresses cannot be worn with safety. When remonstrated with the ever-ready excuse is at hand, "it makes the child hardy." What medical man is there who cannot tell of innumerable deaths the origin of which began in making a child "hardy?"

It seems that many cannot begin this process too soon, for even before their first month is passed I have seen children exposed to the effects of our uncertain climate, and like the early primrose,

> "Too soon deceived by suns and melting snows,
> So falls untimely in the desert waste,
> Its blossom withering in the northern blast,"

many of them are laid in a premature grave. Prejudice will not allow the mother to reason. Her mother dressed her child as she has done, the nurse recommends it, "the child would be such a fright"—and besides all her friends dress their children in a similar manner.

Is it any wonder that in 1880 there were

15,790	victims to	Bronchitis,
5,632	"	Pneumonia,
1,266	"	Congestion of the Lungs,

in all 21,688 deaths of infants under twelve months old?

Enquiry into the cause of these deaths elicits the fact that many of them commenced with a cold—the child "caught a cold." The very words almost condemn the mother or nurse, because the child could hardly, of its own volition, have exposed itself to winds or draughts. I am quite aware that all these deaths have not arisen through the carelessness of the mother, but I am thoroughly convinced, and my experience as a Health Officer, though short, has more than satisfied me that a large percentage of these deaths are entirely preventable.

Time will not permit any allusion to other causes of these, and other respiratory complaints; I will however mention a practice that to a certainty causes a large number of these deaths. I allude to the custom of carrying infants to theatres or churches at night, more particularly in the winter season. The infant breathes the heated atmosphere for hours, after which the delicate lungs are exposed to the great cold of the outside air.

Feedings.—As regards feeding, the great curse of infantile life seems to be the ardent desire of parents and nurses to behold their infants taking solid food; and they wait with considerable impatience for a few weeks to pass until at last they give the infant bread, biscuits, or some specially prepared food, all of which may be very appropriate for a child that has cut some teeth, but which, given in its early days, are frequently the foundation of debility and death.

Lately it has been my duty to make enquiries in Sunderland as to the cause of the great amount of diarrhœa that usually occurs at this season, and I found in many cases that the infants had been most improperly fed, and that there is a great deal of ignorance respecting the food on which infants should be reared. For instance, a child one month old at death had been fed on Neaves' food for three weeks previously; another had been given suet puddings, potatoes, and "everything the same as the parents;" another was fed on raw eggs and bread and milk; while a fourth had been nursed by his mother, who weaned him, and then for only a week, in order to suckle her newly-born infant.

With examples such as these before me, I am not astonished to find that there were in England in 1880—the latest year for which returns are available—

18,578 deaths from Diarrhœa and Dysentery, and
18,486 „ „ Convulsions.

In addition to these there were

20,125 deaths from Atrophy and Debility

for whose causation improper feeding is much accountable. In all there were 57,189 deaths, very many of which were undoubtedly caused by the ignorance of mothers respecting the nurture of their infants.

Some of these from convulsions may have been caused by teething, but teething being a natural process, rarely alone causes death. Personally I have never seen a case of which I could positively affirm "teething caused this death."

In confirmation of this opinion let me point out, on the authority of the Registrar General for Scotland, that whereas in England 35 infants out of every 1,000 die from convulsions, only six die in Scotland. Commenting on this fact he says "there is, therefore, something terribly faulty in the present mode of feeding infants in England, and there is the most urgent necessity for something to be done to arrest this fearful waste of life . . . . . for if the English mortality were reduced to the Scotch standard, 17,000 lives would be annually saved to England. These 17,000 infants . . . . . are truly lives wasted, and these deaths are truly preventable deaths. There cannot be the slightest doubt that the high mortality among the nursing children of England is due to the fact that they get spoon meat far too early in life, before the stomach of the tender babe can digest anything but the mother's milk." And then the Registrar General points out that "As a general rule no spoon meat of any kind is given to infants in Scotland until nine months from birth are expired, or until the child has cut his front teeth."

Facts such as these demand our most anxious thought to devise some means to save such a large proportion of the infantile life of the country, through erroneous feeding.

Ignorance and neglect of the simplest facts of hygiene are also factors in the mortality of infants. It is from this cause that many of the diseases which arise from filthy surroundings arise.

A great essential of an infant life is pure air, yet it is really astonishing to find how generally the custom prevails of covering up the child's head in bed, whether lying with its mother or in its cradle. Strange perversity of custom that the very mother, who will heedlessly expose her child to cold when in her arms, will also adopt the extreme opposite plan of covering it too carefully when in bed! She smothers him with bedclothes, so that if in bed with her, the infant is compelled to inhale the exhalations from the parent's skin, in addition to its own already respired breath. The mother is ignorant of the fact that she is all the time making a miniature Black-hole of Calcutta of her bed or of the cradle.

From suffocation alone there were 1,282 deaths in 1880, and there can be no doubt that the greater portion of these was caused by either suffocation from bed clothes or overlaying.

Filthy air is a common occurrence in the rooms of the working classes. The window does not open, and the crevices between the sashes are sealed with paper, the chimney is stuffed, or the fire-place is boarded over, and even the key-hole is closed to keep out the cold. The uneducated do not understand much about the necessity of ventilation. In their rooms we find the debilitated, pale-faced, consumptive child, while others fade away before they have reached the end of their first month.

Dr. Clarke, of the Rotunda Hospital, Dublin, places on record in 1783, that during twenty-five years there were 18,000 infants born in the institution, of whom 3,000 died in the first fortnight, or 15·5 per cent., whereas, afterwards, when the hospital was ventilated, out of 15,072 infants born alive only 530 died, or 3·9 per cent.

Now it can hardly be questioned that a cause which proved so fatal in a large hospital will also be proportionately fatal in the homes of the people, more especially when overcrowding is present. But when this last-named evil exists we may generally look for two others, namely uncleanliness of person and uncleanliness of the house. Amidst such surroundings as these it will be a rare sight to find a clean baby. Yet newly-born children require perfect cleanliness, and the morning bath is almost as requisite as its mother's milk. Nevertheless this bathing is sadly neglected among the poor, and more especially in the large towns, where dirty children are not unfamiliar sights to our eyes.

Dirt is the truest and most constant ally of disease, and where it leads the way the other surely follows. The mere influence of filth causes children to die at three or four times a greater rate than the standard. In filthy homes and in filthy districts we will find zymotic disease in its deadliest forms, and there we will find those diseases whose main characteristics are diarrhœal.—(*Seaton.*)

When in practice in the South of England, I attended a woman in three confinements, and in each instance her child, although born quite healthy, withered away within a week. The only cause to which I could ascribe these deaths was the filthy condition of the house, in which the very air seemed rancid, even with the windows open to their fullest extent.

Exposure of Children to Infection.—There is another and a most unnecessaay, cause of many deaths, a cause that is solely attributable to the carelessnesss, the rashness, and the ignorance of parents. I allude to the exposure of infants to infectious complaints. It is a usual practice for a mother, taking her child with her, to visit a friend or neighbour whose child, or other member of the family, is ill with some zymotic disease; to sit with her while in the sick room for company, or in case of death to condole with her. I have seen such an occurrence scores of times myself, where measles, scarlet fever, typhus, and even small-pox were present. Some women, it is well known, do this designedly in the case of measles and scarlet fever, believing it is best for the infants to be attacked with these ailments when young. Others treat the matter in a fatalistic manner, and say that if a child is destined to be attacked, it will be attacked when the proper time arrives, and not a moment sooner or later.

I have seen most culpable carelessness on the part of mothers in placing their infants in bed with a brother or sister who was stricken with an infectious complaint. Sometimes this is done thoughtlessly, but often with the deliberate intent that the child might catch the infection, so that at a future period she may be saved the trouble of another nursing. I wondered at their foolhardiness, but can hardly ever wonder again since recently I read in the public press of a populous city a letter from a medical man, advocating, or at all events upholding, the practice of exposing children to light cases of measles or scarlet fever. I trust no people will follow his very questionable practice. Let them recollect that though the disease may be light, yet that it does not necessarily follow that the new attack may be mild also, and that *it might* end fatally. And let them recollect too that, though the fever in itself may turn out to be as the parents desired, there are consequent diseases affecting the kidneys, and other parts, which may leave the children cripples for life.

Perhaps the most heedless risks of all are incurred in the case of whooping cough. Mothers who would sooner cut off their hand than expose their infants to the blighting influence of scarlet fever or smallpox, will, without hesitation bring them into the presence of whooping cough.

There is no sight more painful than a little frail speck of humanity straining and struggling with this complaint. Its little eyes seem to burst from their sockets, the veins in the chest, neck, and face are turgid, and the face itself is purple and bathed in profuse perspiration. The throes of the child are agonizing, and his suffering must be great. The number of deaths from wooping cough annually is about six thousand, many of which are as truly preventable as the accident to ship, the train, or the pit.

Baby Farming.—Baby farming, "the vilest trade that human malignity could have invented," according to a distinguised judge, and one of "the seven curses of London," according to a recent popular writer, is the cause of numerous deaths. One wonders why it is allowed to continue. It should be repressed altogther, or else a more rigid inspection should be made of all houses where children are farmed. For many years past shocking cases of the ill-treatment of children have continually been cropped up, and yet there is nothing done.

The law requires amendment so that the Infant Life Protection Act should cover the case of single infants. At present there must be more than one child received by the farmers before the Act is operative. Meanwhile it is possible for mothers to have their children, who are mostly illegitimate "murdered in single file," murdered, not by a blow, or by a cut, but murdered by improper feeding, murdered by improper clothing, murdered by filth, and murdered by every other kind of neglect.

Hereditary Disease.—I am afraid hereditary disease as a cause of infantile deaths can never be reached until that Utopian time come when the phthisical and others afflicted with constitutional complaints shall cease to intermarry, and when all men and women shall be virtuous, and when drunkenness shall be unknown.

Immorality amongst parents causes the deaths of about 2,000 infants annually, and doubtless there are many more who pay the penalty of their parent's transgressions. Tubercular

Meningitis destroys about 3,000 babes every year, the excesses of the parents becoming a curse to the guiltless children who so recently struggled into life, and who are now relegated to the silent slumbers of an early tomb. Drink, the curse of our country, which so often brings ruin to the home and infamy to the mother, in these cases brought death to the children.

Only three weeks ago I was at a house making inquiries relative to a death from diarrhœa. The room in which the parents lived was most filthy, and in it were the parents and another woman who lived in the same house. I questioned them relative to the time at which the deceased had been first seized, but could obtain no intelligible replies, so that at last I wrote across the page of my note-book devoted to the case, "too drunk to give any information." Within a fortnight I was again in the same house relative to another death from the same cause, but this time it was the child of the woman who was with the other parents.

Midwives.—Every medical man whose practice lies among the artizans is aware that only a comparatively small proportion of them avail themselves of medical skill. They employ midwives, who, as a class, are unskilled, ignorant, and very conceited. When a child is born who does not cry, or who on the application of their rough treatment gives a gasp, and no more, they place him aside, and say he is still-born. If a medical man were present, or if a higher standard of midwives were insisted on, many of these lives would not be martyred by unskilled hands.

Something, too, is required to be done with respect to the registration of still-born infants. At present it is very easy to get them buried. A certificate from the nurse to the burial authorities is all that is needed. It would be well if as at Boston, U.S., these certificates were first submitted to the Medical Officer of Health for his approval, so that a vigilant watch might be kept on all midwives. Dr. Farr is of opinion that something ought to be done, and states that the only cause assigned for their not being registered is that it is difficult to distinguish them from abortions and miscarriages.

Conclusion.—In concluding this paper, the question arises, What can be done to lessen this mortality? I have hinted that the law regarding baby farming requires amendment, and that the registration of still-born infants should be enforced.

As regards hereditary disease, I can only say that people cannot be made virtuous nor the drunkard turned into a sober man by Act of Parliament.

But as regards those large classes of disease that are induced by ignorance, I think something might be done.

Our working population need instruction. They should be more looked after than they are. Greater efforts should be made to impart information to them by means of lectures and addresses on health subjects, not delivered in large halls, which, as a rule, are distant from their homes, but in small school-houses, or other places in their districts. Philanthopic societies, especially ladies' societies, are required to bring the "gospel of health" into their homes. Women can do much with women. This is eminently a woman's mission, but one which is a trying one in our large towns. Yet much can be done, and thousands of lives can be saved, as truly as that the ship would have floated if her ports had been closed, and the train saved if the engine driver had been more careful. In the saving of lives from convulsions alone there is a noble mission.

But this should not be all. Our young population should be taught the rudiments of Sanitation in our schools, more especially in our Board Schools. They might be shown the value of cleanliness, the necessity of pure air, the evils of improper clothing, the difference between wholesome and unwholesome food, and other subjects of a similar character. Far better to do this than to spend money on the higher class education that so many School Boards at present seem to aim at. I believe the well-being of the future generation is largely in the hands of our Board Schools, and as they now embrace or neglect the opportunity of teaching the elements of hygiene, so will that generation be in a far better, or only in a similar condition to our own.

It can do no harm to try the experiment, and it may, and I believe would, do incalculable good.

Let them be taught that they are the gardeners of their own bodies, and also of those little infants who will by-and-bye be entrusted to their care; and that as these bodies are treated well or ill, so will they bud into a sturdy infancy, blossom into the vigour of adult life and bear the fruit of hale old age, or drop from the tree of life as a prematurely withered leaf.

Mr. H. E. Armstrong, M.R.C.S., moved a vote of thanks to Dr. Harris for the paper he had read, and which he was sure they had all listened to with satisfaction. If Mr. Harris had dealt with an oft-told tale, he had dealt with it well, and it was one which could not be told too often.

Dr. Ward seconded the motion. He said that as medical officer for a large district, he could endorse all Mr. Harris had stated.

The vote of thanks was then carried.

On "Bread Reform," by MISS YATES, Hon. Sec. Bread Reform League.

THE relation between food and the progress of the human race is so great that it may truly be considered the foundation of national prosperity and welfare.

The *desire* to obtain food is one of the strongest motive powers which incite to industry the human race. To satisfy the pangs of hunger the earth is cultivated, and the exchange of the products of different countries has created the complicated system of modern commerce, with all its manifold political and social influences. On the other hand, the *choice* of various foods exercises an immense influence on the physical and mental character of different nations. Air and water must be included in the general term of food, for they both nourish the body and sustain life to such an extent that it can be maintained on them alone for a very long period, but deprived of them it is very soon terminated. *Pure* air, *pure water*, and a properly selected diet are necessary for healthy life; and it is generally acknowledged that if these essentials could be universally obtained, most of the diseases which afflict the human race would rapidly disappear. When food plays such an important part in the welfare of mankind, a true knowledge of its properties should be widely taught.

It is to be hoped that this will soon be considered as essential a part of education as "reading, writing, or arithmetic." An educator means one who leads, and surely a State, which has undertaken the responsibility of educating or training the young for the battle of life, ought to teach what is essential for their future welfare.

No one who considers the subject can doubt for a moment that the knowledge of how to obtain health is of primary importance to every one, but for the working classes this subject is most essential, for health is their sole capital. The subject of the right choice of food is for them of the utmost importance, for although sanitary houses and healthy occupations may at present be almost beyond their reach; as they can choose their own food if we can only teach them to adopt what will nourish the body most completely at the least cost, there will be a chance of their resisting the injurious influences constantly surrounding them.

In these days of high pressure and mental strain it is well to remember that to build up healthy bodies is a more precious gift than education and that—

> "It is food which sends out those supplies,
> Which make us both strong and wise.
> If you would improve your thought,
> You must be fed as well as taught."

Surely it is disgrace to our boasted civilisation that whilst farmers have learnt what mixture of fodder will enable them to obtain from their cattle the greatest amount of meat, milk, wool or work, that there should still prevail such dreadful ignorance on the right choice of human food when deficiency of proper nourishment during the period of development and growth may cause much suffering and produce many diseases which might easily have been avoided.

Food is taken into the human body for the same reason as you put coals into an engine to produce the force which moves it. An ordinary engine, however, gets worn out, and you are obliged to have it mended, but the human body has the power of repairing the waste caused by work. Every movement, every thought, wears away a certain portion of the human body. It is, therefore, necessary that the food should contain materials to replace this constant waste. Three classes of materials are required to maintain life, namely, flesh-forming materials, such as albumen, fibrine or gluten; heat-producing materials, such as fat, sugar, and starch; and bone-forming or mineral materials; any single one of them alone will not maintain life. If you feed a dog on heat-producing material alone, such as starch or butter, it will die of starvation.

If you feed it on meat, from which the mineral part has been extracted by soaking it in cold water, the dog will die, just as surely as if you gave him nothing. So that, to maintain life, it is absolutely essential that the food should contain these three materials—flesh-forming, heat-producing, and bone-forming materials—in right proportions. An ordinary mixed diet, of bread, meat, and vegetables, supplies them all; but the present high price of meat prevents thousands of people, especially children, from ever tasting it. As bread is, therefore, almost their sole food, it is of the utmost importance that it should approach as nearly as possible to a standard food. Experiments, made by Drs. Gover and Majendie, prove that white bread alone will not sustain life; for dogs, fed on it, died at the end of forty days; whilst those fed on whole wheat-meal bread throve and flourished.

It is a mistaken idea to imagine that white bread has been long and universally adopted. In the present day, brown bread (not, however, the sham mixture of white flour and coarse bran prevalent in England, but good whole wheat-meal bread) is used by a very large portion of mankind. There are numerous instances of races of people being healthy and vigorous without ever touching meat, when their principal food is good brown bread. The reason for this is, that it contains, in almost the right proportions, those materials which are essential for the maintenance of life—namely, flesh-forming, heat-producing, and bone-forming materials.

In the olden days—although white bread was always used as a luxury by the rich, who had plenty of animal food—the poor, who could rarely obtain meat, lived principally on brown bread.

In Wilke's "Encyclopædia," published in 1810, wheaten bread is described as made from flour from which only the coarse bran has been removed; whilst household bread, or the bread of the people, is described as that which is made from the whole of the grain.

I have been told that in Northumberland it is only within the last thirty or forty years that white bread has been generally adopted in that county; whilst in Devonshire many informed me they could remember when the Devonshire farmers baked a loaf of white bread as we should provide a cake for an honoured guest, and then never baked another for two or three months. It may therefore be considered certain that during the last hundred years a very considerable change in diet has been made by the English people; for during this period they have discarded the bread which had been their principal support during hundreds of years. Meat has more than doubled its price during the last thirty years. Trade and agriculture are in such a depressed state that it is impossible for the working classes to obtain a sufficient amount of animal food. They are therefore almost entirely dependent upon bread to maintain them in health; and the bread they have adopted is one from which a large portion of the flesh-forming, and nearly all the bone-forming, materials are extracted.

It is therefore not surprising that there should have arisen considerable scientific discussion on the physical deterioration of the English race. In an article which appeared in the *Lancet* on this subject, it was stated that our town population, "deprived as they are of fresh air and healthy exercise, combined often with an improper and inadequate supply of food, and consequent resort to artificial stimulants. Such people are growing up under circumstances which can only lead to one result, namely, that of defective development." It is an undoubted fact that there exists an immense number of sickly, stunted, and ricketty children, whilst on all sides we hear complaints that the teeth in the present day are very defective.

The examination of a diagram of the grain of wheat as seen under the microscope will enable you to understand the difference which exists between white flour and what we call wheat-meal. The centre part is occupied with large thin cells, principally filled with starch, the heat-producing material of wheat. Beyond the central starchy mass is a single row of squarish cells, filled principally with gluten, which is the flesh-forming material of wheat.

Beyond these square cells are five thin skins, which form the part called bran. These skins and the germ situated at one end of the grain, contain soluble albumen, a flesh-forming material; cerealine, a ferment which assists the digestion of starch, vegetable fat, and the phosphates which form bones and teeth, and nourish the brain and nerves, and a certain proportion of fibre, about 2 per cent. of the whole grain.

White flour contains from 8 to 10 per cent. of nitrogenous material, whilst whole-meal contains from 10 to 16 per cent. A slight objection has been raised against our movement on the score that the nitrogen of white flour is in the shape of gluten, similar to the fibrine of meat, whilst the nitrogen of the outer portions contains a small part of non-albuminoid (similar to the gelatine of meat), and that the rest is in the condition of soluble albumen and cerealine. These theoretical objections are in no way proved by practical experiments on human digestion, whilst most eminent physiologists state that albumen in food is quite as essential as fibrine. From the fact that albumen is present in the typical foods (milk and eggs), whereas fibrine is absent, the albumen would appear to be of greater importance. The *Lancet* states that Ranke shows very clearly that for the absorption and application in the economy of non-nitrogenous food a certain amount of albumen is absolutely necessary. Its presence, therefore, in wheat-meal bread can be no disadvantage, and is probably most essential. Dr. Pavy states that wheat-meal bread acts as a stimulant to the digestive organs. It has been brought to the attention of the League that people find they can digest fat much better since they have adopted good wheat-meal. If this experience is corroborated wheat-meal bread may prove of good service as a prevention against consumption and other diseases where there is a difficulty in assimilating fat. But the most important difference between whole-meal and white flour is the large proportion of mineral substances that whole-meal contains. The part the mineral elements of food play in the nutrition of the body has only of late years been properly understood.

Mineral substances constitute about one-third of the solid materials of the body. The mineral elements in food are essential for the digestion of the other substances. Dr. Letheby observes: "Bread which does not contain the right proportions of nutritive salts is not properly digested, and passes through the system without any advantage."

The immense importance of these mineral substances will be realised, when it is known there is good reason to believe that their absence or presence in insufficient quantities (either from diminished supplies or imperfect assimilation), will not only make children liable to suffer from bad teeth and rickets, but is also considered to be one of the pre-disposing causes to the fearful scourge consumption.

With reference to this subject I should like to direct the attention of the Congress to and obtain the opinion of the medical men present on a statement contained in a book on "Phosphates in Nutrition," by Mr. M. F. Anderson (published in Coventry). It is there mentioned that after death from starvation, although the body presents the same emaciated condition as after death from consumption, there is a very striking difference in the constituent parts of the tissue. After death from starvation the mineral elements of the tissue are said to be in excess of the normal healthy standard; after death from consumption the percentage of mineral elements is said to be below the normal healthy standard. I don't know if this is corroborated by other experiments, but if true it is a strong argument against the folly of discarding, by costly artificial processes, the mineral elements stored by nature in the grain of wheat. One pound of white flour only contains 49 grains of mineral matter; whilst one pound of whole-meal contains 119 grains. Professor Church states that in 100 lbs. of white flour there is only half a pound of bone-forming material, whilst 100 lbs. of whole-meal contain two pounds of bone-forming material. Every one who keeps poultry knows that unless they are given lime in some form they lay eggs with soft shells, because their food does not contain the materials requisite for making shells. If you attempt to feed children on food deficient in bone-forming materials the bones and the teeth must suffer, for you cannot form bones and teeth out of nothing. Another important advantage of wheat-meal is the large proportion of phosphoric acid it contains, one pound of wheat-meal containing 57 grains of phosphoric acid, whilst one pound of white flour has only 21 grains.

This element is so essential for mental work that a celebrated German has observed, "No phosphorus, no thought."

It is useless to send children to school and examinations unless their food will so nourish their brains that they may derive benefit from such instruction.

The interior of the grain is nearly all starch; the flesh-forming materials increase as you approach the outside, whilst the bone-forming materials are nearly all on the outside.

Fine white bread is made from the central starchy part; household bread contains more of the flesh-forming material, but the truly valuable remainder, which is so rich in flesh and bone-forming materials, is sold to feed cattle, a great waste, for cattle can be fed on many things not available for human food.

In the manufacture of white bread the millers reject from 20 to 25 per cent. of the most valuable part of the grain. Ordinary brown bread is made from the sieved white flour and a sprinkling of the outermost coarse bran, which has very little nourishment, being nearly all woody fibre. Ordinary whole-meal contains all the nourishment of wheat, but it is ground so coarsely that a very large number of people cannot digest it.

Wheat-meal bread should be made from wheat-meal, which after being thoroughly cleansed from the beard, dirt, chaff, &c., is ground, as advised by Dr. Campbell Morfit, in a quasi-granular form, fine enough to all pass through an 18-mesh sieve. Professor Church states that there is no reason, on chemico-physiological grounds, why the whole of the wheat grain should not be digested by the ordinary healthy digestion. It is the mechanical or physical state produced by a bad system of grinding which prevents the ordinary wheat-meal being assimilated by many persons. Dr. Edward Smith says that when finely ground the mechanical irritating effect of ordinary whole-meal is remedied, and the particles so exposed to the action of the gastric juice that the stomach appropriates nearly all the nourishment.

When *properly prepared* the small percentage of fibre (2 per cent. of the whole grain) is advantageous for the majority of mankind, and remedies the constipating effect of white bread, for Dr. Beddoe states, "a moderate percentage of indigestible matter of quality otherwise suitable, is rather beneficial than otherwise to the average healthy adult." For delicate digestions it is advisable to remove the outermost fifth skin of bran, which is nearly all woody fibre. When properly made wheat-meal bread is most palatable and digestible, and so different to the ordinary coarse, hard, heavy, whole-meal and brown breads, that innumerable instances prove that people soon prefer it to the insipid over-fermented white bread generally sold, and find their health improved by its use, and that it sustains and nourishes better than white bread does, and that a larger amount of work can be done on it alone than on white bread, This bread ought to be considerably cheaper than white bread. and contains so much more nourishment, that if you had only 3s. to spend in bread, if you bought wheat-meal bread you would obtain as much nourishment as from the expenditure of 4s. in white bread, a saving of 25 per cent. besides a great improvement in family health and diminished butcher's bills.

When these facts are understood it will be realized how necessary this bread is for those who have little to earn and many to keep.

All classes of society should, therefore, consider this subject. The statesman, who wishes to maintain the nation in that health which is the truest national strength and wealth ; clergy, and all interested in the poor, who should remember that an ill-fed nation is never a wise or a virtuous one ; whilst, if ladies would remember that the word "lady" means "loaf-giver," they might exercise a woman's right which no one could refuse, by securing to their poorer sisters a true staff of life—instead of the broken reed they now lean upon. When it is realised that thousands of children will grow up sickly and deformed, unless some change is effected in the bread which is almost their sole daily food, our cause must appeal to every one who has at heart the good of their country. We earnestly beseech you to listen to the cry of these helpless children ; and, for their sakes, for the sake of the poor children, who are ill-nourished, from being fed on impoverished white bread—and not too much of that—rarely tasting meat food, whilst the materials containing the phosphates and bone-forming substances, which their bodies require, are recklessly and wickedly wasted and cast away : for their sakes, let me beseech each one of you to do everything in your power to promote the general use of wheat-meal bread, as a means of assisting the rising generation, at a small cost, to grow up in health and strength, as they will do if they have a true "staff of life" to sustain and support them.

The Chairman said that they had listened to an address couched in delightful and beautiful scientific language, and he complimented Miss Yates upon the beauty of her address. He trusted that her perseverance would meet with the success it deserved.

Captain Hildyard proposed a vote of thanks to Miss Yates for the reading of her paper.

Professor F. de Chaumont, F.R.S., in supporting the motion, referred to the able and excellent way in which Miss Yates had brought forward her paper, and said that the subject which it embraced was, in his opinion, a very important one. Referring to the bread, he said that with regard to the outer parts, he thought he should feel inclined to advise that they should always be removed, because, besides being tough, they contained a certain amount of silica, which proved extremely irritating to persons of delicate constitutions, especially to children. With regard to the other points, he said he could only cordially agree with what Miss Yates had said.

The motion was then agreed to.

Miss YATES, responding, said that what she meant to convey was that, for the majority of people, if the wheat was thoroughly cleansed from the beard, dirt, foreign seeds, &c., and ground very fine, the outer part would do. It was so much easier to get the whole grain ground fine, that, if persons could digest it, for the sake of their getting the other portions, it was better for them to do so. She thanked the Section for the vote they had passed.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS

By Prof. Henry Robinson, M.Inst.C.E.,

VICE-PRESIDENT OF THE SECTION.

An address to the section of this Congress which deals with "Engineering and Architecture," might be devoted to technical details that would only interest experts. It is however thought that the objects which the Sanitary Institute of Great Britain have in view will probably be better served if some of the broad principles that govern the question of house sanitation, water supply, and sewage disposal, be touched upon with the view of recording the points on which there is a general agreement, and of indicating where changes are called for.

There will be no attempt to introduce novel ideas, as existing data afford ample opportunities for the skill and energy of engineers and architects. To those non-professionals who may hear or read these remarks, it is suggested that they, too, should require nothing novel to attract their attention, as it is considered that the reference to a few facts as to what is occurring every day will afford sufficient food for thought.

The Institute aims not merely at the advancement of technical sanitary knowledge by promoting collections of useful appliances such as those which are brought together in this town, but it also desires either to create or to increase an interest in the public mind with reference to matters affecting health, and thus to secure sympathy and co-operation far and wide.

The work of any institution like this naturally commends itself to the public mind, as it is helping to carry on the great work of sanitary improvement which has already accomplished so much in the direction of diminishing the death rate in the kingdom, and of reforming sanitary evils where they existed.

Some of the pioneers of sanitary science who are still in our midst can testify to the glaring abuses which have been battled with and overcome. To realise this it is only necessary to refer to the Local Government Board Report for 1880-81. This shows that there had been a diminution of 4½ per cent. in the death rate of England and Wales during the last decade, and states:—"It may therefore be roughly estimated that about a quarter of a million of persons were saved from death who would have died if the death-rate had been the same as in the previous thirty years." Further, that "more than three-quarters of this reduction of deaths comes under the head of the seven zymotic diseases, that is to say, of the diseases which are most influenced by sanitary improvements. Of the three quarters just half is in fever, the decrease of which more than any other shows itself in connection with such faults of drainage, of water supply, and of filth accumulation which it is within the province of good sanitary administration to remove."

The Lord Provost of Glasgow, in a speech made at the Institution this year, pointed out the great improvement that had been effected in the health of that town since it had received the blessings of a good water supply, better drainage, and the vigorous enforcement of bye-laws against overcrowding, &c. He stated that the death-rate in that town from 1851 to 1860 was on an average 33 in the 1,000, from 1861 to 1870 it was 30 in the 1,000, and from 1871 to 1880 it was still further reduced to 27 in the 1,000. The saving of life indicated by these figures should impel those administering the sanitary affairs of any town having a high death-rate to set seriously about the improvements which are obviously necessary.

Engineers and architects may agree on right principles, and may devise skilful means for carrying them out, but their field of labour will depend entirely on the appreciation by the masses of the requirements of health. There is less difficulty in getting people to see the necessity for new roads or railways, and to find the money for them, than to find money to make their homes healthy.

In referring to subjects which seem suitable to this section it will be difficult to avoid saying that which must be already known to many. There are, however some truths and facts which bear repetition, and require to be reiterated to force them home to the minds of the mass of the outside public, whose opinion has to be formed and brought to bear on the defects which still have to be dealt with if the proper standard of excellence is to be attained in matters affecting the lives and the health of the community.

House Sanitation.—Captain Galton fully describes in his book on "Healthy Dwellings," the rules which require to be observed in selecting a site for a house and in regard to its internal arrangements. Those who have to deal with house construction and sanitation *de novo* have abundant data to guide them in obtaining the essentials of light, warmth, ventilation, and the like, as well as the conditions affecting materials and details of construction. It should not be considered that arrangements of house drains, waste pipes, &c., are undeserving of the closest attention on the part of the designer of a house, however much they may require a train of thought very different to that involved in dealing with questions of architectural design or of decorative effect.

It is no exaggeration to state that not one quarter of the dwellings of all classes, high or low, rich or poor, are free from dangers to health due to defects with respect to drainage, water, or ventilation which were capable of being easily avoided at the outset. The existence of sanitary defects is not always revealed in a startling manner by results which attract such serious attention as to ensure rectification, as is the case where illness breaks out of a character clearly attributable to bad drainage or water supply. Nevertheless, these original defects will inevitably entail a loss of health and energy to the occupants of the houses, and this may go on for years working insidiously but with deadly effect.

The public are now more alive than they were to the necessity for enquiry into these matters, and consequently sanitary authorities (who cannot go much ahead of public opinion) are better able to enforce regulations, and are more willing to bear the expense of doing so.

To ensure healthy homes local authorities should have bye-laws requiring compliance with general rules which are now well known and hardly require to be specified.

A summary of them may, however, be given for the guidance of those who are not experts.

House drains should be trapped from the main sewer, and should, where possible, be laid outside and not under a house. No connection with a drain should under any circumstances be made inside a house without an efficient trap.

Sinks should discharge outside the house on to the surface of a trapped gulley on the ground level, having a grating communicating directly with the air.

Overflow and waste pipes from cisterns, tanks, lavatories, baths, &c., should not be carried directly into a drain, soil pipe, or water closet trap. A separate cistern for water closets should be provided from that supplying drinking water.

Rain-water pipes, where in proximity to windows, should be cut off from direct communication with the drain.

Soil pipes should, where practicable, be carried outside houses, and should be continued above the roof (but clear of windows) for ventilation.

The connection between soil pipes and drains should be by a curved pipe to prevent lodgements taking place.

The excellent model bye-laws prepared by the Local Government Board afford the necessary data to guide sanitary authorities. They have effected already much good, and a similar code should be in universal operation.

The Metropolis Local Management Act of 1855, as regards the London vestries, and the Public Health Act of 1875, as regards other sanitary authorities, impose on those bodies the responsibility of seeing that the houses are in a sanitary condition. Clauses 73 to 81 of the Metropolitan Act state the essential conditions to be observed in house construction; clauses 82, 83, and 84 give the vestries power to ascertain that these are complied with. The bye-laws issued by other sanitary authorities, and sanctioned by the Local Government Board, have the same object in view. In their operation, however, they are practically applied to buildings which are proposed to be erected, or in some cases to alterations in existing ones.

It is obvious, however, that the condition of the drains, soil pipes, ventilation, &c., of the old houses should also be the subject of investigation. But it is not until the attention of the Medical Officer of Health is arrested by the occurrence of fever, or other form of illness, that their condition is enquired into at all, although they might have been in so insanitary a state as to be unfit for habitation.

The conversion of unhealthy old dwellings (which form so large a proportion of the houses in large towns in this country) into healthy ones, is a task which without reference to bye-laws presents no attractions from an architectural point of view, but has nevertheless to be undertaken by those who are best fitted from their position and influence to deal with the subject.

These observations apply with the greatest force to the houses of the poorer classes, who have not the opportunities of exercising any critical supervision of their own. As regards the houses of the better classes, the same remarks apply to an extent greater than should be the case, considering the irretrievable mischief consequent on treating these matters apathetically.

In order to arrest attention to the condition of houses, and to expose their unhealthy state, the following plan is suggested :

It should be compulsory on the part of medical men, or of the occupier after notification by the medical man, to return to the Officer of Health for the district any case of illness of the classes agreed on as arising from sewer gas, infected water, and the like. This notice should be accompanied by particulars of the house in which the illness occurred, and whether it was an imported case, or originated in the house. It should then be the duty of the Sanitary Authority to have affixed to a plan of the district a coloured wafer or dot corresponding with each disease. This plan should be open to public inspection, as well as any reports explanatory of each case. The effect of this would be that a house, or group of houses, in which filth diseases occurred would be revealed at once to the eye of an intending occupier by the array of wafers, warning the unwary against the danger they are running. Such a visible registration of preventible diseases would reveal where the old houses had been allowed to remain in their original insanitary state. It would also serve as a further safeguard against jerry building, so that a dishonest builder, who had evaded the local Bye-Laws, and escaped detection at the hands of those whose duty it was to see the work carried out as it was approved, would be exposed, and penalties enforced against him.

This proposed visible registration of disease was suggested by Mr. J. W. Batten (Barrister-at-Law) at Plymouth some years ago. He pointed out, after the reading of a paper on "Wreck Charts," that the fever dens and houses in Plymouth, which were unfit for habitation, might be regarded as places in a town where human life was wrecked, and as much required to be indicated in a visible manner as a rock or shoal at sea did.

This suggested registration of disease by maps appears to be in operation in Newcastle. In the *Lancet* of the 16th of this month, it is stated that a map "records, by dots of different colours, all the cases of scarlet fever, enteric fever, typhus, small-pox, and whooping cough, according to the locality in which they are reported." It is further stated that all such cases are voluntarily notified to the Officer of Health. Dr. Armstrong deserves well of all sanitarians for having introduced this system.

A means of compelling enquiry into fatal cases of typhoid and enteric fevers, and similar diseases arising from preventible causes, would be to require an inquest to be held, at which evidence would be elicited which would point to the cause of the disease, and the necessary steps to remedy the mischief would follow.

An illustration of this is afforded by a case reported in the *St. James's Gazette* of the 20th, as follows :—An inquest was held yesterday by Dr. Danford Thomas on the body of a woman—the wife of a gasfitter—who died in the Middlesex Hospital, according to the verdict of the jury, from blood-poisoning. The drainage of the house in which the deceased woman and her husband lodged, in Ann Street, Soho, was, it was stated, defective, and the illness from which she died was, there could be little doubt, caused by the polluted atmosphere she inhaled. "Defective drainage," said a medical witness, "brings on diptheria in some, pyæmia in others." A notice to the sanitary authorities of the parish was agreed to by the jury; and the case will, it is hoped, lead to a thorough examination of the drainage of other houses in the district. It is painful to know that, after all that has been done of late years in the way of sanitary improvements, persons still die almost daily, poisoned by the drains that should save life, and not destroy it.

On the efficient way in which the plumbing and sanitary work in a house is executed depends, to a large extent, whether a house is healthy or not. Experience proves continually that much of this work is done by incompetent or careless people, and requires subsequent rectification, probably after illness has caused an investigation to be made. In America, legislation has aimed at correcting this evil by making it a penal offence for plumbing work to be badly carried out.

The necessity for vigilance on the part of local authorities over buildings of a certain class cannot be better brought home to the public mind than by quoting from one of the reports of Colonel Frank Bolton, the water examiner of the metropolis, who states, "Now, as heretofore, it appears to be the rule in building a certain class of houses to place the cistern over the water-closet, with an untrapped waste-pipe communicating with the drains. These cisterns are often open, and regularly receive the drippings from the roofs and gutters; they are, moreover, in close proximity to the dust-bins and other deposits of filth and garbage, while children amuse themselves by throwing all sorts of dirty rubbish into the water, including dead puppies and kittens, with an occasional cat."

When a house is let by a landlord it would be presumably fit for habitation. There can be no doubt that equitably this condition ought to apply both to furnished and unfurnished houses. It is assumed by anyone either purchasing or hiring a house that it is habitable, and is in a proper sanitary condition. A recent trial, however, led to an exposition of the law by Mr. Justice Watkin Williams. He explained that it is only furnished houses to which, without a special covenant, there is an implied warranty of healthiness; so that, if a house is let unfurnished, the occupier cannot cancel his tenancy if he finds it in a bad state. The remedy is for an intending purchaser or occupier of a house to require a certificate that certain stipulated conditions have been fulfilled. This would render it necessary for the landlord or vendor to ascertain (what is only equitable that he should) that the house is fit for habitation before he derives any benefit from his property in it.

Similar certificates should be required for all new houses, and no one should be allowed to let or sell a new house until the local authority had given a certificate. This would involve more inspection and a larger staff than now exists, but the cost of this might fairly be borne chiefly by the builders, who should pay according to a sliding scale. The cost should not fall wholly on the rates. This plan is now in successful operation in several towns, and heavy penalties are imposed where a house is allowed to be inhabited without a certificate. The cost of the increased staff, no doubt, will be thought an objection, were it to be charged on the rates, especially in a town where, as frequently happens, the members of the governing body for the time being prefer a low rate to such safeguards as those indicated.

Those who have to struggle against either the ignorance or indifference of the public as to the sanitary safety of their dwellings, or who are striving to frustrate the machinations of jerry builders, will concur in the desirability for some further legislation in the direction suggested with reference to the detection, registration, or avoidance of preventible disease.

In dealing with cases of supposed defects in the drainage, or other sanitary arrangements of a house, the first difficulty is to ascertain what has already been done. It too frequently happens that the records only show what was proposed to be done, and sometimes not even that, with respect to matters of real importance. This is avoidable, and it is necessary to impress on all who are either engaged in constructing new houses, or altering old ones, to preserve a careful and intelligent record of the arrangements which have been carried out by them.

At the Annual Conference on the Progress of Public Health, which was held at the Society of Arts in 1880, this point was referred to by Mr. Stansfield, who spoke with the experience derived from his previous position as President of the Local Government Board. He said: "I, as owner or occupier, or any person who purposes to buy, want to know whether a house is healthy; some inconvenience occurs, some evidence of its imperfection and unhealthiness, and I want to find out what it is. I ought to be able to go to the local authority, and say, it is your function and your duty to look after the healthworthiness of this house. You compel me to drain into your sewers, and you are bound to future occupants of the house to show them, by plans, the nature of the connection between the drains and the sewers."

Pail System.—It should be regarded now as settled with reference to the removal of excreta, that the water-carriage system is the proper one to aim at adopting. The pail or tub system has still its advocates whose opinions prevail occasionally, and lead to its use. It should, however, be confined to the few exceptional cases where small groups of houses cannot be connected with a sewerage system.

Arrangements for dealing with the excreta from a house other than by drains, is considered by sanitarians to be a mistaken principle, inasmuch as it does not dispense with a sewerage system for the removal of other than domestic filth.

The pail system has no doubt been introduced with advantage into places where the previous state of affairs was the old privy, or the fixed midden systems. As either of these involved the certainty of the refuse being kept for a longer time than is consistent with sanitary rules, a moveable receptacle is an improvement.

Arrangements for the retention of fœcal matter in a house, whether for a long or short time, are objectionable on sanitary and sentimental grounds. On sanitary grounds if it is kept for a long time, and on sentimental grounds as regards its visible removal.

It should, however, now be regarded as beyond controversy, that a water-carriage system of sewerage has to be eventually introduced into every town, and that whatever measures have to be resorted to from local or other causes, they should only be regarded as temporary.

Mr. Rawlinson, C.B., C.E., when referring to the pail system in the Blue Book of 1875, properly described it as an "expedient."

The circumstances under which the employment of the pail system would be justified are well stated in the report of Dr. Netten Radcliffe to the Local Government Board in 1875.

Separate System.—It is a matter of great importance where sewage has to be pumped or purified in some way at the outfall, that the bulk of the surface water should be excluded from the sewers. Natural channels or water courses could be utilized to receive surface water in cases where they would not be allowed to take sewage. The volume to be conveyed to the outfall would be reduced to a more constant quantity, enabling the sewers to be smaller than is possible where they have to receive large and sudden volumes of rainwater. The difficulties of pumping and purifying would be also reduced.

The local authority is required, under sec. 15 of the Public Health Act, to provide sewers (sewer being defined to include "sewers and drains of every description,") which will effectually deal with both the sewage and the surface water that arises in or finds its way naturally into their district.

Just as the local authority is bound to provide sewers sufficient to take sewage proper and also surface water, so on the other hand the owner or occupier has a right, under sec. 21, to carry surface water as well as domestic sewage into the sewer.

Under Section 21 of the Act, the householder has the right to drain his premises into the public sewer, subject only to the method of connection being approved. The premises are so defined by the Act as to include, with the building, the land, and easements appertaining to it. The sanitary authority has no power to compel the observance of any bye-law which they might pass at variance with this, as bye-laws and regulations are intended to further the purposes of the Act, and not to restrict or get rid of them.

If, however, the local authority adopted a duplicate system of sewers, one for sewage proper and one for surface water, it appeared that it had no legal right to put in force a bye-law compelling the owner or occupier to separate the surface water from the sewage.

It is thought that such a practical difficulty should be remedied by giving the local authority power to compel the surface water to be carried into channels specially provided for that purpose, and thus enable the separate system to be put in force where it was advised to be carried out. The surface water thus excluded must not be too polluted, as is the case with road water in large towns.

Sewerage.—As the object to be accomplished in a system of house drains is to effect the immediate removal of the fluid refuse from the house, at the same time sewer gas is, by effectual trapping, prevented from coming into it from the main sewer, so that which has to be accomplished in a system of sewerage is to continue the prompt removal of the fluid refuse away to the outfall.

Certain rules require to be rigidly adhered to in sewerage works, and admit of no dispute. Amongst others, straight lines between lamp-holes, or man-holes, or at changes of gradients, are imperative. Without provision for inspection, no sewerage works are properly designed, and sewers cannot be efficiently inspected, and obstructions removed, if the above rule is departed from, unless the sewers are large enough for a man to walk through.

Abundant flushing and ventilation are essentials. In some cases ventilation of the main sewer has been accomplished by carrying pipes up adjoining houses, or up the public lamps, or by furnaces and stacks. The thorough flushing and ventilation of the public sewer, like the perfect flushing and ventilation of the private house drain and soil pipe, are of the first importance. Even where a sewerage system is well devised as regards gradients and natural or artificial flushing, frequent ventilators are necessary for the escape of sewer gas, the increasing and diminishing flow at different times of the day acting with a pulsation which causes natural ventilation. Where, however (and this applies unfortunately to a large number of cases), the sewerage system has not the merit of being self-cleansing, and collections of dangerous matter can arise, artificial flushing is required, and ventilation ought not to be confined to the usual openings from the sewer to the surface, but artificial means must be adopted. It has been suggested, that it should be compulsory, in building new houses, to construct a shaft, not less than six inches in diameter, from the house drains up to the roofs of all houses, and to ventilate the public sewer through the private house drain and soil pipe. There would appear, however, to be an objection to this. To ventilate the main sewer through shafts forming part of the structure of a dwelling would involve the danger of sewer gas passing into and around the house through the brickwork itself, either by percolation or by means of cracks, or in consequence of alterations. It is considered to be desirable to treat the ventilation of the main sewer as having to be accomplished independently of the ventilation of the house drains.

Sewage Disposal.—Having dwelt on the means whereby fluid refuse is best removed by a system of sewerage, it is desirable to refer to the important and difficult question of how it is to be disposed of. No general rule can be said to apply, and each case must be dealt with according to the conditions which govern it. Considerable advance, however, has been made in the last few years in the direction of reducing the difficulties which hitherto existed within a much smaller compass. It is agreed that the fertilizing properties of sewage should not be wasted if they can be utilized at a profit. Suitable land of sufficient area offers the natural means for this purpose. It is, however, often impossible to find it at a reasonable distance for an outfall, in which case an alternative has to be resorted to.

The question should be regarded as a combination of sanitary and agricultural interests, the first being paramount, and if the second be incompatible with the first it must be disregarded.

Time does not permit of the various means whereby sewage can be dealt with and purified, with or without the utilization of its manurial properties, being considered; but reference will be made to some recent experiences and opinions in regard to the application of sewage to land.

In a valuable paper read this year before the Society of Arts by Mr. Warrington, on "Nitrification," the question of the purification of sewage by filtration through the soil was entered into. The production of nitrates in the soil is known by chemists to be due to a process of oxidation, and it is found that nitrification in the soil is caused by the action of a living ferment of the bacteria family, and that sewage itself will supply the substances required for the nourishment of the oxidising organisms. Also, that sewage containing the organisms necessary for the destruction of its organic impurities only requires to be applied to a filtering medium, favourable as to composition and as to intermittency of action, to ensure the fermentation being carried on to completion. The double result follows, namely, of purifying the sewage and of depositing the nitrates thus produced in the soil for the purposes of vegetation, nitrates being the form in which nitrogen is chiefly assimilated by plants.

It was pointed out in this paper that the purifying action of soil on sewage was due to—1. Simple filtration or removal of suspended matter. 2. The precipitation and retention by the soil of ammonia and various organic substances previously in solution. 3. The oxidation of ammonia and of organic matter by the agency of living organisms.

After describing the interesting chemical actions which take place, it was shown that it would be possible to construct a filter bed having a greater oxidising power than would be possessed by ordinary soil and subsoil, and that such a filter bed could be formed by "laying over a system of drain pipes a few feet of soil obtained from the surface (first six inches) of a good field, the soil being selected as one porous and containing a considerable amount both of carbonate of calcium and organic matter." A filter bed of this kind was considered to be far more porous than a natural soil and subsoil, and would possess active oxidising functions throughout its whole depth.

As the presence of antiseptics was found to interfere with this fermentation, it follows that refuse from chemical works would hinder the purification of sewage by the soil.

An artificial filter has been made at the Merton Sewage Works by Mr. Latham. Here a dense clay was met with, which was dug out over an acre and burnt into ballast. A filter bed was formed to a depth of five feet by alternate layers of ballast with six inches of surface earth, and this filter is stated to be purifying the sewage of about 14,000 people. It was calculated that, allowing for the necessary rest, a similar filter over ten acres would suffice for the population for the whole year.

Dr. Lawes and Dr. Gilbert have long pursued investigations at Rothampstead as to the chemical changes that take place in the soil under varying circumstances, and have published much valuable information. Dr. Angus Smith, one of the inspectors under the Rivers Pollution Prevention Act, 1876, in his report to the Local Government Board this year gives a great mass of valuable information relating to the chemical investigations he has for years been making, and amongst them are data as to the action of air on sewage, and to the mode of treating sewage so as to hasten aeration. Dr. Smith in the same report, as well as in his previous report of 1879, refers in detail also to the treatment of sewage by chemicals. These accumulated experiences are now available for the guidance of engineers in disposing of sewage.

In addition to the valuable practical results deducible from Mr. Warington's experiments another series of observations deserves to be referred to as of use to the engineer engaged in sewage disposal.

Dr. Walker and Mr. McKie conducted a series of experiments in Carlisle in 1881 on the purifying effect of soil when used under the same conditions as exist in nature. Full details of these experiments were published this year in my book on "Sewage Disposal." * The conclusions arrived at were that land of the kind experimented on at Carlisle, which consisted of loamy earth, overlying sandy subsoil, well drained, might purify the sewage of about 500 people per acre without regard to agricultural results. A table in the same book shows that an average of 19 towns where broad irrigation was practised gave 137 people to the acre.

With reference to chemical treatment or precipitation of sewage, the knowledge which has been gained is being applied quietly, and free from the strong influences which prevailed a few years ago when irrigationists and precipitationists were in constant conflict to the confusion of those who had to advise local authorities in disposing of sewage. Experience now proves that where chemicals are required in aid of filtration the simplest are the best, and these can be obtained in the open market without resorting to patented systems of any kind. The rule to observe is to employ chemicals that produce the minimum bulk of sludge. This admits of being the more readily

* Robinson on "Sewage Disposal." Spon, London.

disposed of either by drying by exposure to the air or in filter presses.

Those who have to advise in regard to sewage disposal should avoid being identified with any system, thus preserving an impartial position which will enable them to deal with the circumstances of each case free from prejudices.

The practical aspect of the sewage question is now most favourable for engineers to deal with the sewage of a town. Where land can be obtained of the necesary area and quality the original views of irrigationists can be carried out by the utilization of the manurial properties of sewage on a large area. Where it is not possible to obtain a large area, or where the land is clayey and not suitable for filtration, it need no longer be assumed that chemical treatment must necessarily be resorted to, although in some cases it is desirable. A small area of land can be converted, as already described, into an artificial filter capable of purifying large volumes of sewage without chemical treatment.

As the various difficulties which existed a few years ago in regard to the purification of sewage have now been diminished by the further knowledge that has been gained, it may be reasonably expected that the Rivers Pollution Prevention Act of 1876 will be made more operative than has hitherto been the case. If sewage continues to be discharged into a stream without the "best practical and available means" required by the Act having been employed to render the sewage harmless, it is not for want of clear data to show how it can be purified, as the issues that have to be decided are now very much narrowed.

Water Supply.—With respect to the rules which govern the selection of a source of water supply for a town, it sometimes occurs that chemical analyses of samples of water are relied on solely as furnishing all the data necessary. Chemical analyses, however, without observance of the condition of things surrounding the point from which the sample of water was taken, do not suffice. This is specially the case where the sample is taken from a river which is liable to contamination by animal organic matter, or from a shallow well which is supplied by surface water, without the necessary depth of filtering and oxydizing strata intervening to remove impurities.

Chemical analyses cannot detect pollution due to infected animal matter, neither does an analysis enable a distinction to be made between nitrogen in the water as organic compounds of a dangerous kind, and nitrogen in the form of harmless inorganic salts of ammonia, nitrous or nitric acids.

The way to ensure perfect safety in a source of water supply would of course be to exclude waters which cannot be considered as theoretically free from the possibility of pollution. This is advocated by some, but it would necessitate giving up all river water, except that at the fountain head, and adopting subterranean water. The heavy cost involved in obtaining this perfect supply would lead to a restricted use of water, with the consequent insanitary results that would follow from such restriction.

The water supply for the metropolis is mainly from the Thames, which is a river certainly not free from sewage pollution, even at the points of intake. Yet it is well known that the districts consuming it, in its filtered form, are as healthy as those adjoining which consume deep spring water.

By exercising careful judgment, and with a full knowledge of the conditions requiring observance, an engineer can select a source which will satisfy the reasonable requirements of the case.

A constant supply is essential for sanitary reasons. The evils resulting from an intermittent supply are many. For instance, it involves storing the water and the risk of the receptacles being polluted, even in the houses of the better classes, much more so in those of the poor. This cannot better be illustrated than by quoting from one of the official reports of Colonel Frank Bolton, the water examiner for the metropolis. He states, in speaking of these receptacles, that "many of the cisterns, tanks, and butts for containing water in small basement houses in the metropolis are in a disgusting and filthy state. Cisterns may be seen without lids, and with portions of rotten lids floating in the water, full of rank and decaying vegetation, and other most objectionable substances, such as old rags and paper; and, in closer examination, the contents show more or less organic deposit, and under the microscope would be found to abound in infusorial life."

The different terms in which analyses of water are rendered by chemists is the cause of inconvenience to engineers engaged in cases of water supply, and it is very desirable that a better agreement should exist by which impurities in water were returned under precisely similar headings, so that engineers had not to work out a comparison between an analysis of water which is in terms of "albuminoid ammonia," and one in which the impurities are returned as "nitrogen in the form of nitrates and nitrites."

Further Legislation.—Further legislation on certain matters is necessary to meet altered circumstances, or to enable the experience which has been gained to be put into operation.

The arrangement of sanitary districts, according to the old Poor Law divisions, requires modification.

The distinction between urban and rural districts in regard to the power to make bye-laws regulating buildings and streets or roads is anomalous, inasmuch as many districts that were rural at the time the Public Health Act was passed have so changed by the increase in population, and its congregation in large groups, as to have become urban in parts of it, and to require the same bye-laws as urban authorities have.

According, however, to existing legislation there is no power on the part of rural authorities to make bye-laws regulating buildings, streets, or roads, even where the conditions of population are similar to those which obtain in urban districts.

Manufactories in some cases have been erected outside urban districts in order to avoid the borough and general rates. These works lead to houses being built around them without, however, being under sanitary supervision.

The establishment of a county authority over areas capable of being combined conveniently owing to their physical features, appears to be a subject for future legislation. This authority (which it has been suggested, might consist of the chairman of each local board in the county), should have power to dispose of many matters of detail which now occupy the time and attention of the authorities at Whitehall.

It has already been pointed out in speaking of the separate system, that a modification of the Act is needed to enable the surface water of premises to be excluded from the sewer where the sanitary authority requires it to be done after providing a separate sewer.

It is desirable that a heavy penalty should be imposed by law where a house was let or sold when in an insanitary condition. Parliament has made it an offence to sell food which is unfit for consumption and a danger to health. It should be made an offence to sell or let a house which is equally a danger to health.

What is required is that existing anomalies and ambiguities in legislation be removed. (The Police and Sanitary Committee, presided over by Mr. Sclater-Booth this session, accomplished useful work in the direction of maintaining uniformity of bye-laws.) That compulsory powers should be substituted for permissive in every matter connected with the department of health. That a central local authority should have power to deal with matters concerning the group of local authorities in its county. And (as has been often urged) that a Department of Health, with a permanent chief, might be created.

Conclusion.—The training of those who are appointed to positions such as Surveyors to Local Boards and Inspectors of Nuisances, requires careful attention. Their duties are important ones, and good or bad results follow the efficient or inefficient discharge of them. Men filling positions of this kind ought to be required to comply with some test, or to pass some examination. They should also be more independent than they are of the influence of members of the authority whom they have to serve, and this can only be effected by making their appointment incapable of being cancelled without the consent of the higher authorities. On the conscientious and efficient discharge of their duty by those who have to carry out sanitary work, depends the health and welfare of the community, and a negligent or incompetent person can produce enormous mischief. This responsibility, whilst entailing a corresponding anxiety to those engaged, is accompanied by the knowledge that their work is one which, if well done, results in diminishing the death-rate and improving the health of those in whose midst they are called upon to devote their energies.

Captain Douglas Galton, C.B., said he was sure they would all agree with him that a most hearty vote of thanks should be given to Professor Robinson for the very able and practical address he had given to those assembled. He quite coincided with the view which Professor Robinson had enunciated at the end of his address—that they should, as far as possible, make their sanitary improvements depend upon local and not upon centralized action. He had long felt that they had solved many problems which related to the larger questions of sanitation, but there still remained a very great deal to be done in the way of the sanitation of their houses. No doubt they had the Artizans' and Labourers' Dwellings Act, which enabled the worst tenements to be pulled down, but there remained still an immense number of houses which could not be touched under that Act. Of course, it was very difficult to interfere in the case of every individual house, but he had always thought that if new houses, both in the town and the country, were subject to the approval of some local authority, so that no new house should be built unless it satisfied sanitary requirements, they would make a very rapid increase in the number of their healthy dwellings. As bearing upon this question, and the importance of improving the dwellings of artizans and other labouring classes, he would mention that a letter had just been put into his hands, addressed to the Mayor of Newcastle, and the President and Members of the Sanitary Congress, and which came from a person signing himself as one from the lower ranks, a Yorkshireman living in London. He would read the letter, which was as follows :—

"Honoured Sir and Gentlemen.—Permit me, as one in the lower ranks, and a Yorkshireman by birth (Clifford-cum-Boston), who for over a quarter of a century has been associated with the lower strata of society in the Metropolis of England, and so privy to some of the trials and sufferings that class endure, to state that notwithstanding the great improvements made in their places of abode from a sanitary point of view, having special regard to air and drainage, yet to this day, and even in the most recently erected houses, within four miles radius of Whitehall, London, we have thousands of dwellings to which water is conveyed in a pure state into the iron cistern and therein polluted by the foul air arising from the W.C. through the pipe from the cistern. Two years ago, I occupied the front parlour of one of ten cottages belonging to one landlord, and situated in Ebenezer Place, Camberwell Road, London, S.E., when three children in the cottage were taken ill. Having a desire to know the nature of the complaint, and, if possible, the cause which led to it, I made inquiries, and Mr. Norman Elliott, the medical man of Denmark Hill, certified to the fact that their illness arose from the poisoned water they drank, combined with the bad drainage. Thus certified, I represented the matter to the Sanitary Inspector of St. Giles' parish, Camberwell, who paid an early visit to the premises. The result was that the landlord had early notice given him to remove the causes by good drainage and unpolluted water, and these were thus secured to ten dwellings. My chief object in giving you a case in point is, that you will be pleased to consider and formally recommend a medium of action to be taken, legislative or otherwise, to accomplish the object. I remain, honoured sir and gentlemen, Isaac Clifford Wood, artizan, 31, Hollydale Road, Queen's Road, Peckham, London, S.E."

That, said Captain Galton, only illustrated very clearly what Prof. Robinson had told them about the pollution of water in cisterns, and it was also very strong evidence of the great necessity for enforcing, as far as possible, a constant water supply in dwellings, especially those occupied by the poor.

Mr. E. C. Robins, F.S.A., said he had very great pleasure in seconding the motion for a vote of thanks, for Professor Robinson had gone into his subject in an extremely practical manner, and the speaker thought that the headings of the subjects sufficiently indicated the extreme value of the paper. It would take up a very long time to discuss all the topics of such a comprehensive paper as this, which in the case of a President's address was unusual, but he was sure they would all agree that the whole subject had been reviewed in an eminently instructive manner. One of the most important parts of the paper was that which dealt with suggestions for the improvement of the law. The whole system of sewers, there was no doubt, must eventually be re-organised. He had great pleasure in seconding the motion.

The motion was then put and carried unanimously.

Professor H. Robinson, C.E., said he was very pleased at the attention with which his Address had been listened to, and at the way in which the vote of thanks had been proposed and passed. The trouble it had given him to compile the Address would be abundantly compensated for.

"*On the Desirability or otherwise of providing Town and Country Houses with Grease-intercepting Chambers to Scullery Sinks,*" *by* W. Eassie, C.E., F.L.S., F.G.S.

A subject of some considerable controversy among practising sanitary engineers is the treatment of grease and fat in water-borne sewage between the scullery sink and the outfall into the sewer. For grease makes a law unto itself, and this law is interpreted in several ways.

It must be at once conceded that fatty matter will congeal and become solidified, rising to the top of the water, and that it will sometimes reach the sewer, especially when the underground house drain has a great fall. But on the other hand, it must be admitted that it will not *always* reach the outfall, even with a reasonably ample fall, and that it has a tendency when cool to adhere to the inside of the traps, and to the sides of the drain, in some cases eventually stopping them up. I thought that perhaps a few remarks upon the subject might interest some members of the Section.

It is supposed by many that there is no necessity whatever for any special treatment of the grease which is sent into the house drain from the scullery or kitchen sink, and this is made a hard and fast rule. This might be taken as correct were the house to be treated a cottage or small villa, with but a few inmates, say eight or ten in number, because the quantity of produced fats in cookery and washed-off grease from pans and plates would be inconsiderable, and a liberty might be taken in supposing that the bulk of the grease would reach the sewer, and that it would ride safely in globules to the sewer on the surface of the flushing water. But the case is varied, and a new issue joined, when the house to be dealt with might, by courtesy, be termed a *mansion*, and when some ten or a dozen of the family, and a retinue of servants—steward, butler, and under butler, housekeeper, footmen, cook, scullery maids, still-room maid, house maids, and odd men—are all in residence. The grease introduced into the drain under these conditions is, to say the least of it, enormous; and its passage into the house drain is facilitated by a plethora of hot water, and by careless or thoughtless scullery maids who will not take the trouble to scrape off any superlying grease from the interior of the pans before cleansing them for next usage.

Given a six inch, well laid, drain pipe, with a clear outgo inside, free from obstructions due to unequal collaring, and even smooth as salt glaze or glass glaze will make it, is it to be supposed that because such a drain will work well in a small house that it is certain to do so with a residence of any size—an hotel, or club, and the like? I venture to think not, and the difficulty is in no way obviated by enlarging the size of the drain; indeed it is then very often increased, because there is more surface for the grease to cling to when the wetted perimeter of the pipe is enhanced during a sudden flushing of the drain, intentionally or during a storm.

In any residences where such a number of persons reside that neither the word cottage or even villa will apply to designate them perfectly, the quantity of sand used in the scullery for cleansing and scouring the copper and iron pots and pans is enormous, and sand being so cheap a commodity, I question whether any one has fully taken into account the cubic feet of this material which must descend into the drain during a single month, when the residence is in full swing, with added guests, and the servants of the visitors to swell the number.

I do not think for a moment that any amount of fall in the drain or flushing power from the scullery taps would suffice to scour out all this sand to the drain. At least, I have never fairly yet met with an instance where, in a large establishment, the sand did not cause a stoppage in the drain, when no interceptor had been provided. The sand might be dispatched to the sewer, were it sand pure and simple, but it has now become clogged with fat, sticky, and almost irremoveable in consequence.

If, in all cases, the scullery sink were near to the outfall into the sewer, for instance close to the front area, and a properly built disconnection chamber, one might perhaps venture, even in a large establishment, to rely upon the fat-laden water being driven to the sewer. But unfortunately in the bulk of houses, and in large mansions especially, the scullery sink is situated at the far end of the premises, sometimes a hundred feet or more away from the flap in the sewer. And if it be a risk to take when the house is a small one, the family few, and the drain a short one, with a splendid fall, that every particle of grease shall reach the sewer, what shall be said when the drain is a very long one, the gradient bad and cannot be improved, and the residents at a palatial figure? Surely here some provision must be made for grease interception, plus the sand factor.

It may appear that this is simply slaying a dead lion. But this cannot be so characterized, because some engineers of note say that they never yet saw any necessity for grease interception, and, therefore, never provide for it. All I will venture to say on this head is, that were they to revisit their clients' mansions after a few years had lapsed they would often see unmistakeable signs about the root of the scullery waste pipe that the stone flags had been up more than once, and intermittent discomfort regularly anticipated, to the benefit, doubtless, of the jobbing builder.

One great objection to the collection of cooled-down grease in a house drain is that no amount of hot water or chemical material will once more solve it. Moreover, there is the constant attraction which grease always offer for rats. I have several times exhibited pieces of sink waste pipes formed of lead over a quarter of an inch in thickness of material, where the pipe has been gnawed away until the rat could enter the house. They were not satisfied, perhaps, with the food conceded them in the sewer, but they wished perhaps, to explore the El Dorado "through the looking glass." There can be no doubt that rats enter house drains chiefly in search of fats, and every one will admit that when once in a house drain they will soon emerge from it, even when the house drain is surrounded by concrete—always provided that the lead pipe continuation is large enough to pass its body. Syphon traps in the line of the drain cannot safely be relied upon, because, for curiosity, I have made rats to dive through the hydraulic seal in order to escape their pursuers. When there is no syphon, only a flap-trap at the eye into the sewer, the case is worse, because sewer rats can creep behind a non-tightly closed flap-trap—and what flap-trap remains closed long?—as easily as a cat will paw open a larder or pantry door.

When it has been decided to collect the grease and sand from a scullery sink, it is a very improper method of doing so by placing an open trap in the floor just under the scullery sink. This, before long, gives off the most offensive smells, and no amount of cleaning-out of the trap will remove its traces. While at the same time, the evil is accumulative.

It is better to place it outside the house, if this primitive plan of a mere trap is resorted to; and a very good trap of this kind is Dean's trap, exhibited at the Exhibition buildings by Messrs. Rimmington Brothers & Co., of Newcastle-upon-Tyne.

The usual kind of trap used for grease collection is the common mason's, or dip-trap, and the scullery waste-pipe is not furnished with a syphon, but is dipped into the trapping water. A much better contrivance is now in common use. Here an access-tap is fixed under the sink-soffit, and the lead pipe is carried to a tank and delivers its conduitory over the water inside the tank. The out-go pipe is trapped by being bent down, and the fat is collected from the top of the water after a time, pure enough, in some country places, to feed pigs with.

It is really a question, *en passant*, whether the fat could not be made to pay for collection, instead of being buried away. I knew the manager of the establishment near Barking outfall of the metropolitan sewers, and he informed me that the fats collected and refined were extremely valuable, and that only the haphazard collection was to blame.

One of the best grease interceptors which can be used for automatically flushing out the drain as well is Mr. Field's flushing tank. It will serve these purposes whether in stoneware or iron; but if the house be a large one, and there is a site out of doors handy, and the fall suitable, an iron one is preferable, because it congeals much more quickly the fats, and they cling to the cool iron readily, forming, so to speak, an inner girdle of grease, which thickens as time rolls on, and is easily removed in cakes. I am sorry that Mr. Roger Field's punctiliousness as a Judge at the Exhibition forbade him exhibiting; but I dare say all here present know the contrivance in question.

Another grease collector, very nearly approaching to Mr. Field's in pattern, is one just introduced by Messrs. Doulton, of Lambeth, but I have, as yet, no experience of its working or staying powers. Messrs. Doulton are manufacturers of other patterns of grease traps, of more ordinary construction, which act very well.

A grease-intercepting tank, formed of stone-ware, much used by those who approve of grease traps, is that of Mr. Hellyer's. The grease enters at a dipped pipe, some little below the standing water level, so as not to disturb the congealed head. The hot greasy water is cooled in its transit to the outlet, and the fatty particles rise to the top. The outlet is at the further end, and there is a hand hole to the head of the inlet mouth. There is a ventilating pipe, a cast-iron cover properly luted, and a brass plug and washer with iron handle and pipe for emptying the tank and flushing the drain when the superjacent fat has been removed, and when the depth of the drain will allow of a flushing pipe below the outlet at the top of the grease chamber.

Such is my attempt to assail the stronghold of those who do not entertain the necessity for grease interception. It is only begging the question to say that the building of a grease tank is a return to the old cesspool system, which cannot be true, because nothing but fats should enter the grease tank, not even other sink wastes, rain water, or surface deliveries. Certainly the subsided matter is foul and the floating material the same, but provided the trap is cleaned out regularly, all will prove soundly beneficial to master, wife, and servants alike. And the safe rule, when such a contrivance has been once supplied to a house, is to engage with some person to clean it out, for a given sum, so many times per annum, using plenty of ground lime. Surely it is as easy for a servant to bear this necessity in mind, as it is for her or him to remember that their quarter's wages are due on a given day.

The CHAIRMAN said he had great pleasure in proposing a vote of thanks to Mr. Eassie for his paper.

Mr. R. B. GRANTHAM, C.E., seconded the motion, and said it gave him very great pleasure to do so, because the paper and the suggestions contained in it were extremely practical. The speaker said he was not so much engaged in house drainage as in main drainage, but he had of course to consider how every kind of house drain could be discharged into the sewers. Mr. Eassie had had very great experience in this matter, and was so well known that they might rely upon what he had so well described in this paper as being the best way of getting rid of the grease. The speaker had also had some experience in this matter, and he had found a very great amount of inconvenience and annoyance, and, he believed, injury to health, caused by removing the grease. He knew of one case in Hampshire,—a large establishment, where the grease was immediately outside the house, just under the scullery window, and they had the greatest difficulty in getting rid of it, because the effluvia coming from it was so strong. The men were obliged to have handkerchiefs tied round their mouths to prevent their being sick. The speaker said he thought at the time that the cesspool was not large enough to hold all the grease, and that it would not be many months before it would get stopped again. It collected at one side, and almost stopped the outlet into the main sewer. He had listened very attentively for the remedies which were suggested. He used hot water, and had succeeded in removing the grease. He was very glad to hear of the system which Mr. Eassie had alluded to in his paper, and that it was available for the purpose. He had been laying some sewers in one town where a question arose as to the use of flushing tanks, and he had given the matter his consideration. Simple as the matter appeared to be as a branch of the sanitary question, it was really of considerable importance, and he was very glad to have had an opportunity of seconding the motion.

The motion was then put and carried.

Mr. H. Saxon Snell, F.R.I.B.A., said he did not propose to question the desirability of putting grease traps in any establishment, but it appeared to him that very often these grease traps were placed where the necessity for them did not exist. The question was, in large establishments where hot water was used in large quantities, did the fat congeal before it passed the trap? He thought not, and that in the very best constructed trap that could be devised a very small proportion of the fat which came out of the sink or the scullery was actually caught in the trap. In very cold weather it might be, and then the contrivance, which was shown on one of the diagrams, would prove valuable. It was a very difficult thing to make an experiment in a matter of this kind, but he felt convinced that a very small proportion of the fat from the kitchens of public institutions would ever be caught in grease traps such as were proposed by Mr. Eassie, and the conviction was forced upon him that they would prove to be a delusion. One point which had been suggested was that other water should not be allowed to go into the grease trap; but his opinion was that it should, for it would assist in coagulating the fat.

Mr. E. C. Robins, F.S.A., said the last speaker had remarked that it would be a difficult thing to make a practical experiment, but he had been forced to make one, and he would give the Section the result of his experience. In a previous house he lived in, he had no trouble with the matter, and he had no grease trap. In his present house he put in the drains, and he was twice annoyed within twelve months with a stoppage of grease. His wife had previously objected to the use of a grease trap, but now it became necessary for him to invent some such method for preventing the nuisance. He proceeded to describe at length, and gave a diagram of his method for doing this, saying he never had his drain stopped again. The trap he had used did catch the fat, and to his mind it only remained a question of whether a large trap, requiring to be cleaned out once a month, or a small one, to be cleaned out by the servants of the house every day, was the best. In the latter case the accumulation of fat could be removed by the servants of the house with a spoon, without inconvenience from offensive effluvia. The water below the level of the outlet rapidly became very foul, and required frequently baling out.

Mr. D. Emptage stated that he had laid in scullery sink drains, both with and without grease traps, and had paid considerable attention to the subject, and his experience led him to the conclusion that these traps were an evil. One case particularly had come under his notice, and this was a public institution, having upwards of three hundred inmates. At this establishment the scullery sink drain was 9 in. in diameter, 250 feet long, with a fall of 1 in. in 48 in., and an intercepting trap to catch the grease. This trap was always choking up, great inconvenience and an abominable smell being the result. He had the trap removed, and the drain relayed with very even joints, having a clear run throughout. The drain had been working now for three years, during which time he had frequently inspected it, and had always found it working satisfactorily.

Mr. Hubert Laws, C.E., gave his experience of grease traps, and said that upon examination, he always found there was a large amount of grease collected.

Mr. E. W. C. F. Schmidt, Dr. Russell, and Mr. Alcock also spoke upon the subject, and Mr. Eassie briefly replied.

"*The Separate System of Drainage,*" *by* Mr. J. Lemon, M.I.C.E.

I have selected this subject, because it is one upon which difference of opinion exists between sanitary engineers, in the hope that it may be well ventilated at this congress.

In the early days of sanitary engineering when that veteran sanitary reformer, Mr. Edwin Chadwick, C.B., advocated sewage purification, the principle of "The sewage to the land and the rainfall to the river," met with considerable support, but the opponents of this system discussed it with considerable virulence. Mr. Chadwick, Mr. Rawlinson, and others were nicknamed "The quart into a pint school." They were accused of the enormous crime of wishing to dispense with brick sewers altogether, and drain large towns through small pipes. The controversy as to the respective merits of brick and pipe sewers waged fiercely, and in the mêlée the separate system was more or less ignored.

About this time the main drainage of London and other large cities was under consideration, and it was very easy to prove that small pipes for these works were useless. Happily we have now passed through this stage of professional intolerance, and the drainage engineer designs his sewers in accordance with the work which they have to do, and the advocates of brick sewers or pipe sewers for all purposes exclusively no longer exist. During the consideration of the question of admitting the rainfall into the main sewers of London, careful analyses were made by Professor Way of the surface water as taken from the streets, and the results showed considerable pollution. It was ultimately decided, as most engineers are aware, to admit ¼ inch of rainfall in 24 hours into the metropolitan sewers, and to provide for excessive rainfall by storm overflows into the river Thames. This decision of Sir Joseph Bazalgette and the consulting engineers gave a most decided check to the separate system of drainage.

Sir Joseph Bazalgette, in the paper read by him at the Institution of Civil Engineers, in the year 1865, stated that the "separate system" would involve a double set of drains to every house, and the construction and maintenance of a second series of sewers to every street. Applied to London, it would involve the re-draining of every house and every street in the Metropolis, and, according to a moderate estimate, it would lead to an expenditure of from ten to twelve millions of money, while the interference with private property would alone render such a proposition intolerable. I need not say that this expression of opinion from an eminent drainage authority was another heavy blow to the separate system.

In the year 1867 I submitted a scheme in public competition for the main sewage of the City of Winchester on the separate system, and was awarded the first premium.

During the consideration of the various schemes I was bitterly assailed in the local press for advocating what were called "The obsolete principles of the General Board of Health." I held my ground, and I have since had the satisfaction of carrying out the works, and being able to report that there is not a single gully connected with the sewers in the city, although the roof water and water from back yards is in some cases admitted.

During the last 10 or 15 years the separate system has rapidly regained the lost ground, but in order that it may not have another relapse I wish to put before the Congress the principles upon which I consider it should be carried out:

1st. What is the "separate system," so called? Does it mean the *entire* and *absolute separation* of the rainfall from the sewage? If so, then I say at once there is no town in England where it is carried out. It is a common practice amongst its opponents in order to hold it up to ridicule, to assert that it does mean an entire and absolute separation of the sewage from the rainfall, but Mr. Edwin Chadwick was always in favour of admitting the roof water from houses and the water from paved surfaces such as streets, mews, courts, alleys, and paved squares, so that even he was not in favor of the separate system pure and simple.

There is no town I know of where there are such natural facilities for carrying out the system in its integrity as at Winchester. The city was formerly drained into cesspools in the chalk, and the surface drainage was carried into the brooks and the river at all available points. In the scheme I adopted, I simply left the surface drainage alone, and provided for the sewage and a small quantity of rainfall from the houses, feeling confident that a margin for rainfall under the most favourable circumstances was necessary. The city passed stringent bye laws, which were ably carried out by the city surveyor and his assistants, but in spite of all these precautions, some portion of the rainfall is connected with the sewers, and the flow in the sewers at times of rain is considerably increased.

2nd. Is it desirable to entirely exclude the rainfall from the sewers in all towns and under all conditions?

To that question I say no. In my judgment it is neither desirable nor practicable for the following reasons, viz:—

No. 1. The rain is a scavenger, and carries away the impurities from the surface of our streets and courts in the thickly populated towns.

No. 2. The rain flushes the drains and sewers in towns destitute of all other modes of removing deposits.

No. 3. The rain can be stored and used for flushing purposes by the use of Mr. Roger's field flush tanks, and the drains and sewers kept clean, noxious gases therein being thereby prevented.

And No. 4. The quantity of rainfall to be excluded from the sewers must entirely depend upon the size and character of the town, the means of sewage disposal, and other local circumstances.

Having given the above reasons for the partial admission of rainfall under certain conditions, I may state I do so in the interest of the separate system, as I am convinced the advocacy of its use absolutely, in all towns under all conditions would defeat its true progress, and be as unwise as the former advocacy of pipe sewers *versus* brick sewers for the Main Trunk lines in the Metropolis.

The class of towns and the conditions under which the rainfall should be kept out of the sewers as far as practicable, are as follow:—

Towns where it is necessary to pump the sewage on to land for purification.

Towns where it is necessary to pump the sewage for treatment by precipitation.

Towns where it is necessary to pump the sewage for treatment by precipitation and intermittent filtration combined.

Towns where the sewers are tide locked, and it is important to decrease the quantity as much as possible.

The other class of towns in which the rainfall may be partially admitted into sewers, are as follow:—

Large and thickly populated towns where the impurities washed from the streets and courts would seriously pollute the river into which the town is drained.

Towns drained into the sea by gravitation where there is a free discharge at high water.

Towns where the dry system is in operation.

It will thus be seen that I have divided the towns into two classes, with the view of separating the rainfall from the sewage, as far as practicable, and at the same time not putting the separate system where I considered it would be out of place.

The advantages which I claim for the adoption of the separate system in the first mentioned class of towns may thus be briefly stated.

By the separate system the quantity of sewage to be provided for is more accurately ascertained, the areas of the sewers are, consequently, better apportioned to the work they have to do, and deposits therein, and consequent noxious gases from sewage decomposition, thereby prevented.

The power of the engines and dimensions of pumps can be calculated on a more reliable basis, as it is not necessary to allow a large margin, or to provide large surplus power to meet storms and sudden gluts of rainfall.

The capacity of the reservoirs, or tanks for precipitation, can be less, and can be designed by the engineer with tolerable accuracy.

The area of land for irrigation can be less, and the disadvantages and difficulty of pouring large quantities of diluted sewage upon lands in times of heavy rain are thereby removed.

In tide-locked sewers, the quantity of sewage is reduced, and the consequent flooding of basements and cellars prevented.

The silting up of the sewers by the detritus from the roads and streets during heavy rains (a very serious matter where pipe sewers are used) is also prevented.

The advantages which I claim for the admission of the rainfall in the other class of towns, under certain conditions, are as follows:—

In large towns with paved surfaces it is less costly to admit the rainfall than to construct special culverts for surface water, the distance from the river being so great in most cases that a system of surface drainage would be necessary. The washings from the paved surfaces are so highly impregnated with organic matter that it is desirable, in order to prevent pollution of the river, to intercept it by the sewers and deal with it in the same way as ordinary sewage.

In such towns I advocate the removal of a given quantity of the surface drainage, that is to say, the first portion of a storm or fall of rain, which is always highly impure, by the sewers, and the removal of the last portion of a storm or heavy rainfall which is comparatively pure, by means of specially constructed storm water culverts on the principle adopted by Mr. Bateman and recommended by Mr. Baldwin Latham.

By this simple arrangement a given quantity of sewage can be received into the sewer, and when it is exceeded the whole of the discharge would flow into the river by the storm water outlet.

This is a far better arrangement than the storm overflows to the main sewers in London and other large towns.

In cases where towns are drained into the sea by gravitation at high water there is no object in separating the rainfall from the sewage, and storms and heavy rainfall can be provided for by properly constructed overflows much more economically than by separate surface drains.

In the case of the dry system so much in vogue in the midland districts of England, the adoption of the separate system would be out of place. The sewers in such towns are mostly surface culverts, and although they also take the slops, and the discharge from them is very impure, there is not that necessity for keeping the rainfall separate; and as most of these towns are paved towns and come under the before-mentioned category, the sewage can best be dealt with on what is known as the single system.

It is a curious fact that in towns drained on the single system the local authorities have been compelled to supplement the sewerage system by surface drainage, London being no exception to this rule, showing clearly that the provision made for the rainfall is in most cases inadequate; and the flooding could be prevented by the judicious utilization of the existing valley lines.

Next in importance to the disposal of rainfall is

Subsoil Drainage.—In some cases it may be said to be more important. It certainly forms part of the separate system, and the same arguments in favour of the separation of the rainfall can be used in favour of the separation of the subsoil water.

In the Blue Books, on town drainage, medical men bear testimony to the decrease of phthisis in well drained towns by the lowering of subsoil water. How is this effected? In some cases it is due to the subsoil water following the line of sewer, through the newly made ground by the sides of and over the sewers. In other cases it is due to imperfect jointing of the pipes and the pervious character of the brick sewers.

That such a valuable portion of the sewerage of a town bearing, as it does, a large part in the reduction of the death-rate, should be left to chance and imperfect workmanship, every engineer will admit is not creditable to the profession.

I do *not* mean to say that subsoil drainage is wholly neglected, but I say its special treatment is an exception to the rule.

I give herewith the quantity of subsoil water admitted into the sewers in the following towns, from returns made by the Local Government Committee :—

Town.	Sewage per diem, including subsoil water.	Subsoil water only.
Kendal	750,000	350,000
Warwick	700,000	one-third subsoil water.
Coventry	1,220,000	500,000
Rugby	400,000	150,000
Harrogate	168,000	83,000
Chorley	500,000	200,000
Bradford	700,000	300,000
Penrith	1 of sewage to 3 of subsoil water.	

It will thus be seen that the subsoil water forms in some cases nearly half the quantity of sewage, and this diluted sewage is pumped up, and poured on to land in addition to the rainfall.

In a monetary point of view, the question of subsoil water is more important than the rainfall, as the expense of lifting it is continuous, whereas rain falls on the average about 155 days in the year.

To remedy this defective construction, I recommend the adoption of a separate system of subsoil drainage in all water-logged soils, so as to relieve the sewers of the influx of spring water, facilitate the construction of the sewers, and reduce the working expenses.

I have carried out such a system in Winchester with the best results (a cross section of the sewer and subsoil drain is submitted), and I shall always adopt a similar course under the same circumstances and conditions.

By the observations I have had the opportunity of putting before the Congress, it will be seen that I wish to establish the principle of partial separation of the rainfall in certain towns, and the separation of the subsoil water, but that no fixed law can be adopted by engineers which is applicable to all towns under all conditions. The question of the adoption of the separate system, and the extent thereof, must be entirely governed by local circumstances.

I hope that civil engineers will now look upon this question, not as a matter of controversy, but that they will deal with it with the same judgment as they did the question of brick and pipe sewers, that is to say, lay down no fixed law, but adopt the provisions of nature to the use, the convenience, and the health of man.

The CHAIRMAN asked the Section to give a hearty vote of thanks to Mr. Lemon for his paper.

Mr. LYON seconded the motion, which was carried unanimously.

Mr. R. B. GRANTHAM, C.E., said, that at Slough they had succeeded in separating the sewage from the surface water by means of separate pipes. The system of drainage which formerly was carried out could not be used. A new system of sewers was therefore laid down, and care was taken that only the sewage went into them. They had purchased 25 acres of land, and this was so far more than required for their purpose that it had not been necessary to crop all of it up to the present time. The land was let, and the person who leased it did what he liked with it. The soil was a very fine one for the purpose, and took all the sewage they required to pump. There was a population of 5,500 inhabitants on an area of 13 acres. They had to lay three-quarters of a mile of the sewage pipes under the level of the Thames at high water, for which purpose iron was used, which increased the expense. They found it necessary only to pump about four days a week, and the rest of the week they were ready for any circumstances which might arise. At ordinary times, they found that four days a week was quite sufficient for their purposes. The lift of their pump was 25 feet, and the length of the rising main a mile and three quarters.

Mr. E. PRITCHARD, C.E., said, he had listened with very great pleasure to the reading of this most valuable paper upon what might be considered to be a most important part of the sanitary engineer's work—the construction of sewers. Every town or district must, of course, be governed by its own conditions, and he thought that the reader of the paper had very clearly laid down that he did not gainsay this important fact. As to the question of the non-admission of rainfall into sewers, there were some instances where it would be practically impossible to do this, and he gave as an instance the town of Birmingham. The separate system of sewers would not mean merely a separate system, but a triplicate system.

Mr. G. J. SYMONS and Mr. E. SCHMIDT also took part in the discussion, and Mr. LEMON replied.

On "*Dr. Renk's Observations on Sewer Gas, and its Exclusion from Dwelling Houses*," *by* EDWARD COOKWORTHY ROBINS, F.S.A.

IN my address at the Royal Institution, on the occasion of the Anniversary of the Sanitary Institute, I referred to the original researches of Dr. Pettenkofer and his chief assistant, Dr. Renk, undertaken at the Hygienic Institute of Munich; and I detailed the result of their experiments on ground air, which proved that pressure of the ground air through the floor of a basement was greater than the resistance, but that it might be drawn off through subterranean channels by the kitchen chimney flue.

To-day I propose to refer to Dr. Renk's pamphlet on sewer gas, detailing the results of his experiments in house drainage; and I do so in accordance with my own suggestion in the aforementioned address—viz., that this Institute should be the repository of the records and results of original scientific research, of interest to sanitarians, and of importance to the welfare of the people, as their best insurance against preventible disease.

With the proverbial fulness of detail of German writers, Dr. Renk devotes many pages to elementary introductory matter, for it is remarkable that the Germans are behind us in Sanitary appliances in connection with house drainage; and the subject not being so generally well understood in Germany, the necessity for an elementary treatment is greater in his case than it would be in ours, thanks to our sanitary authors, and to this and kindred Institutes.

But in the matter of warming and ventilation of public buildings (not private ones) they are far ahead of us, and treat the matter with a scientific seriousness which is not common in this country.

It is always interesting to observe how different minds arrive at similar conclusions, more especially when those conclusions are attained by independent investigation and scientific experiment. And since no single appliance is for ever applicable to all possible cases, it is valuable to add to our resources.

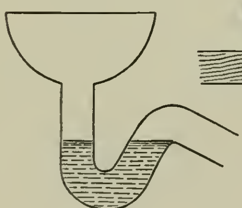
Dr. Renk opens his paper with an explanation of the term sewer gas, and gives a resumé of the experiments which have been made on the composition of sewer gas, and the amount of gas given off by the decomposition of excrementitious matter, through which we need not follow him, since these things are fully gone into in Dr. Parkes' work. He admits the presence of solid particles, bacteria, &c., but expresses himself a disbeliever in the so-called sewer gas theory; that is to say, while he believes that inhaling sewer gas is prejudicial to the nervous system, and is one of the many causes of the impurification of the air we breathe, he does not consider it provocative of specific forms of disease, and he questions the possibility of solid and liquid particles passing from sewage into the superincumbent air—shewing that he is unacquainted with the researches of Professor Frankland, whose paper on this subject at the Royal Society, has determined that "The breaking of minute gas bubbles on the surface of a liquid, consequent upon the generation of gas within the body of the liquid, is a potent cause of the suspension of transportable liquid particles in the surrounding air."

The diagrams at the end of his pamphlet, some of which I exhibit, illustrate his discussion of the causes which lead to the escape of sewer gas, and of the best form of syphon traps to resist the pressure of sewer gas.

Fig. 10, plate 1 (*see fig.* 1), is important as shewing a case where in consequence of the waste-pipe between the two sets of closets "running full" the water is sucked out of the upper floor traps, and is forced out of the lower floor traps, in each case forming a passage for the sewer air.

Dr. Renk points out that the mere height of water in a trap is no necessary indication of its comparative efficiency; thus, in the figures 2 and 3, where, if both limbs of the syphon are of equal area, and the height of the vertical or longer side is made sufficient, the resistance is equal to a column of water double the height of that contained in one limb. But if the area on the side of the drain be less than on the opposite side, the resistance is equal to that of a column considerably less than double the height. In the opposite case the resistance is considerably greater. Thus, supposing the column on either side to be 5 centimetres high, if the areas are in the proportion of 1 : ·55 the resistance is that of a column 7.75 centims. high;

FIG: 2.



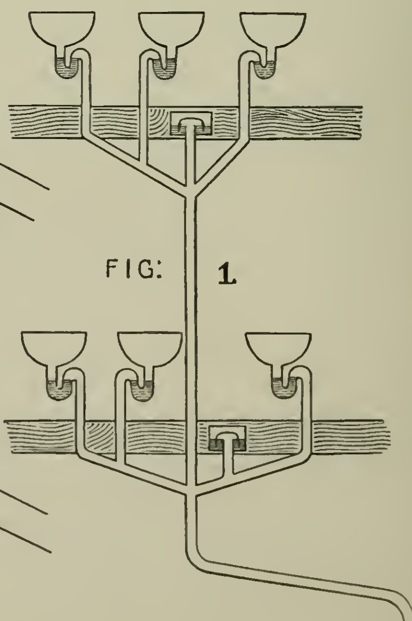
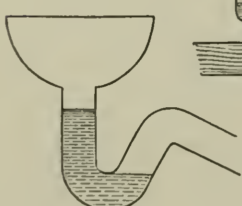


FIG: 1.

FIG: 3.



if they are in the proportion of 1 : 1, the resistance is that of a column 10 centims. high; and if they are in the proportion of 1 : 9·4 the resistance is that of a column 23 centims. high. This is supposing the pressure to be exercised from the side of the drain.

The evil arising from the rapid evaporation of the water in all the ordinary bell-traps has led Dr. Renk to invent a special form of trap, reducing the area of water exposed to the air to its smallest limit.

Under the outer grating is a plate, perforated by tubes equal in area thereto, which descend to near the bottom of the well of the trap, while the central outlet drain-pipe rises between them to two-thirds the depth of the well as shown on his drawing, thus obviously answering the end proposed, but from its liability to be soon choked it is of questionable value.

The application of this trap to basins, baths and cisterns is also shown. Syphon, ball and gully traps have now superseded bell traps, which are as obsolete as pan water-closets in modern practice.

But after all, such expedients do not prevent the necessity of ventilating the soil or waste-pipe, and Dr. Renk has shown Prof. Pettenkofer's plan of doing this. Prof. Pettenkofer continues the soil-pipe above the roof, and above the highest connection therewith he places a gas jet to quicken the draught by raising the temperature of the air at that point, and Dr. Renk would put no cowl on the top, not believing in them. It is pretty well agreed now that, except for the prevention of down draft, cowls are of no practical use.

He also considers that there is nothing gained by having air inlets at the foot of soil-pipes, and he points out that from the position in which these are often placed they are more likely than not to lead to the contamination of the air in rooms near to which they are situated.

He gives a drawing on the same sheet showing that extract ventilators in rooms where there is not this upward suction in the soil-pipe, are apt to draw the air into the room through the sink or w.c. from the cesspit.

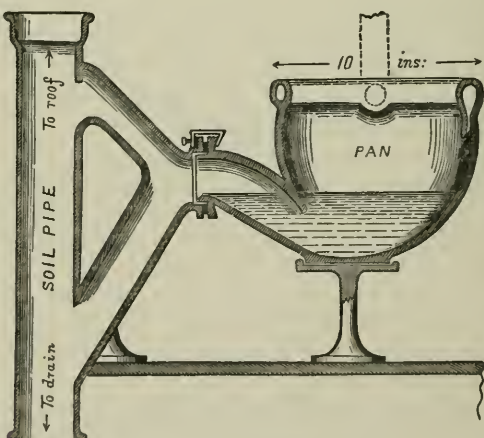
Cesspools are common in Munich, and the pneumatic system for emptying same, is adopted, as it is in France, but it is less well done than by Mons. Tallard's process, which was exhibited at Kew, as I experienced to my own annoyance, when, on my way to Pettenkofer's Hygienic Institute, I had to pass on the opposite side of the way to where an operation of the kind was in progress.

The pressure of the air in pipes would in all probability be much less in such circumstances. It is where the storm waters suddenly fill the sewers and compress the air, and force it through the house drains into the houses, that so much care has to be taken to have a perfect system of air and water intercepting agency.

The conclusions of Dr. Renk, to which I have adverted, are all based on careful scientific experiments and analyses, of a character quite unsuitable to introduce into a cursory notice of his labours such as this.

I have received from Chicago, in America, from the inventor, a description and illustration of a form of water-closet basin and ventilated waste, called "The *Hygienic*," which, to my mind, overcomes very many of the difficulties besetting other apparatuses. It is in process of being secured by patent, and is known to many present.

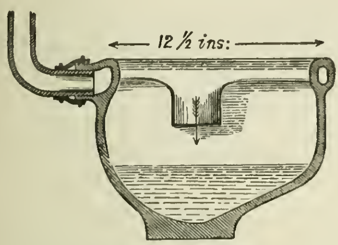
The triangular arrangement of the pipes forming in one piece a portion of the soil-pipe, with its two branches of large area, is connected to the outlet from pan by cramps, screwed up with India rubber washers between the flanges. The downward branch is the outlet for soil and water, the upward branch is the passage for air, and the junction of same with the basin is midway.



Sectional Side View.

By this means the exit arm from the closet is perfectly ventilated by the upper arm, no pressure is put on the water seal, and the point at which the pan is fixed to the washer is get-at-able, and capable of perfect junction.

The form of basin is good, the scour of the water is certain, and the whole has more good principles combined in its simple construction than I have seen for some time, and practically solves many of Dr. Renk's problems.



TRANSVERSE SECTION OF PAN.
(Looking from the Back.)

I may add that in America the soil pipes are made of cast iron, with lead caulked joints, often pitched internally, and fixed inside the premises, and are carried up through the roof.

The CHAIRMAN moved a vote of thanks to the reader of the paper.

Mr. J. LEMON, C.E., seconded the motion.

Professor F. DE CHAUMONT, F.R.S., made a few remarks on the subject, with reference to the proposed form of closet, and pointed out some objections to the forms of closet commonly used which had not been entirely met in the one under consideration.

Mr. D. EMPTAGE pointed out that the closet which Mr. Robins had brought before them was fitted with a basin similar to that used for a valve closet. It was an excellent shape for that purpose, but was, in his opinion, quite unfit for a direct-action closet, to flush which effectually three conditions must be observed. The first was that there must be a sufficient quantity of water, and at the least two gallons; the second, that it should be delivered quickly, or in five seconds; the third, that the contour of the basin should be such that the water would fall direct upon the contents of the trap. In this last particular, he said, the basin before them was very defective. The water streaming down its sides would have a tendency to cause the contents to ride up rather than to force them through the trap.

Mr. S. ALCOCK said he had heard of some means of intercepting sewer gas before it entered houses. He described an intercepting man-hole which he had adopted in connection with his own house, and had found valuable. The drain itself was open by a half pipe at the bottom of the man-hole, which was kept continually sweet and well ventilated by means of a pipe or shaft, and it also enabled them to test each house drain, and see whether it was working efficiently.

Mr. R. B. Grantham, C.E., said that at Slough great complaints were made of the gratings in the middle of the streets, and at first great nuisance was caused by the discharge of the accumulations from old cesspools into the sewers. Occasional flushing had improved the air in the sewers. The gratings were then covered over with zinc plates; but since that ventilation had been effected by means of the gas lamps, and iron pipes carried up the sides of houses.

The motion for the vote of thanks was then put and carried unanimously.

Mr. E. C. Robins, F.S.A., stated, in reply, that the conditions required by Mr. Emptage were certainly attained by the example he had quoted in illustration of a practical solution of the theoretical difficulties raised by Dr. Renk. The volume of flush-water is discharged immediately opposite the exit orifice—its force is accumulated by the form of the lower part of the pan—by using a syphon-action water-waste preventor, the whole two gallons would be discharged at once through a one-and-a-half-inch service pipe. There was no second trap to be cleared. The dip was into the basin water itself, and in this was like Pearson's trapless closet; but no plug was required and no second basin. Mr. Alcock was quite right in his observations about man-holes. The plan now generally adopted was to provide a shallow man-hole both in the front and back areas of houses in terraces separately admitted to the public sewer: the drain between these points to have no inlets: all branch drains to meet into one or other of these man-holes by channels perfectly straight: no drains to be laid in a curved form: the portion of the tubular drain pipes within the man-hole should be open, the upper half of the same being omitted: and a syphon-trap to cut off the sewer air to be fixed on the sewer side of the front man-hole. This system aërating the intercepting man-hole met the difficulty arising from the passage of air bubbles containing germs from the sewer side of the water seal of an ordinary syphon-trap to the house side of the same.

Sewer Ventilation, by W. Geo. Laws, M.Inst.C.E.

It is unnecessary, before a meeting of Sanitary Engineers, to enter into any discussion as to the necessity for the ventilation of Sewers, and the writer proposes only to bring forward some objections to the usual mode of doing this, and to suggest a method by which it may be more rationally and effectually carried out.

The usual method of sewer ventilation is by an open grating on the manhole, which allows any sewer gas to pass away directly into the air. Sometimes a more complicated arrangement includes a wire basket filled with charcoal for the purpose of deodorizing the gas. So long as this charcoal is fresh it does, no doubt, absorb some of the gases, but, in a very short time, it becomes inert, and, unless often renewed, is of very little use.

The main fault of this system is that when effective in carrying off the sewer gases it, at the same time, ensures their being delivered at the point where they are most objectionable, viz.: at the street-level, where, before they are dissipated they must come in contact with, and be breathed by the passers by. The manholes are usually in back streets, close of course to some of the back doors, where the inmates frequently stand to gossip, where in the poorer parts of the town children constantly play, and where the wheeled traffic being least the gas is more slowly mixed with the air. Who that occasionally passes through a back street, cannot recall some sickening, full flavoured whiff that made him quicken his space, while glancing round for the cause, and instinctively "noting" the "honest British grate," which serves at once to mark the progress of sanitary science, and to distribute its blessings? Who that has seen children playing round such a grate, dropping stones through the bars, or watching the foul stream below, can doubt that here may be the cause of many an outbreak of fever, or case of blood poisoning?

The ventilating grate is frequently also the cause of mischief in another way, for the sticks and rubbish that are swept or pushed through it often are the immediate cause of a stoppage in the sewers, which may, or may not, be soon betrayed by the more rapid exit of noxious effluvia at the nearest vent, and which can only be remedied by flushing, or opening the drain. Before this is done one or more houses may have been flooded by the gas and serious mischief done.

The narrow back street, with the yard walls on either side, forms a complete trough, which, on a still airless night, may easily be filled, two or three feet in depth, with very slightly diluted sewer gas.

As a means, indeed, for securing that every passer-by shall breathe the greatest possible amount of poisonous gas, the arrangement is almost perfect—as an outcome of sanitary engineering effort it is depressing—indeed it is only to be surpassed, in effect, by some of the more ingenious contrivances, by which the enterprising builder succeeds in "laying on" sewer gas to the rooms of modern houses, and, like Samson, slays his thousands, but with a more effective weapon; going cheerfully on his way upheld by a conscious rectitude of intention, and a happy ignorance of the startling success of his efforts.

Sanitary Engineers have long recognized the fact that no water trap is secure against occassional pressure of gas in the sewers and drains, which must, and does, more or less effectually break the water seal and allow the gas to pass into the house.

They have therefore very generally adopted the plan of carrying an open ended ventilating pipe from the soil pipe at least up to the eaves.

This effectually prevents pressure on the closet or sink traps, and is a most commendable arrangement.

Architects, however, are very naturally averse to disfiguring their elevation by an unsightly pipe, and the result frequently is that this safety valve of the drains is rendered worse than useless by being terminated at, or even below the eaves. Few who read these lines but can call to mind some instance of an open soil pipe ventilator, ending with a handsome cap, within a few feet of a bed-room window, into which, if open, the gas must be blown in at least one direction of the wind.

This open ended soil pipe is, however, the true germ of efficient and safe ventilation, not only of the house drains, but of the sewers. All that is necessary is that it should be connected directly with the drain or sewer, *without a trap*, and that it should be carried to the highest point of the building, above all windows and openings.

This would be effected by forming the soil pipe of well-glazed sanitary pipes, such as are now used for the best chimneys, and building it into the chimney-stack—making, in fact, a separate gas chimney—through which all noxious gases from either drains or sewers could freely escape.

This "gas-chimney" should preferably be laid alongside or between the kitchen chimneys, the heat of which being partly communicated to the gas would assist in securing an upward draught in all seasons. The sewer gas would be delivered among the freshly made and finely divided carbon of the smoke from the kitchen fires—a most powerful deodorizer and disinfectant—and it would be delivered far above all occupants of the houses or passengers in the streets, securing, at least, that before it reached them it must be very largely diluted, and so rendered less harmful.

It has frequently been proposed to ventilate the sewers by erecting tall chimneys with a furnace to create a draught, and connecting them with the drains. This seecms feasible at first, but has one fatal objection. The sewerage of a large town may be compared to the "arterial" system of the body —the flow of *gas* is naturally towards the capillaries (the house drains); and to render the furnaces effective, it would be necessary either to erect the shafts over the main drains in the lower parts of the town near the outfalls, and so reverse the natural course of the gas and make it flow in the same direction as the sewerage; or to add a "venous" system to collect the gas from the house drains into larger "veins" upon which the furnaces could be placed; or otherwise to place a furnace shaft at the end of each house drain.

This latter is practically the system proposed by the writer, as every house drain would terminate in a warmed ventilating shaft, while openings would be provided in the lower parts of the town on the main sewers to allow of the entrance of fresh air.

It is a system that could be readily and economically carried out in all towns which have the power of making building regulations. All builders of new houses might be compelled to provide the additional "gas chimney," and the cost would be so small (about 50s. in an average three story house) as to create no opposition among the builders, while architects would not object to a plan which makes no unsightly blot on their elevations.

Among houses already built, its introduction would be of course slower and more costly, but even there the constant pulling down and rebuilding going on in the heart of large towns would soon secure a sufficient number of ventilators in each street—a dozen gas chimneys, for instance, would amply ventilate a 3 ft. × 2 ft. main sewer.

Naturally to this, as to all systems, objections can be raised, and we may consider some of them.

Firstly. The dangers of leaks in the gas chimneys.

This danger is more apparent than real. In the first place, it is not beyond the skill of the average builder to joint a 6-inch or 9-inch sanitary clay pipe so as to be practically gas tight; and in the second, being open ended, there is absolutely no pressure within it, and therefore no tendency to leak.

Secondly. The danger of a down draught instead of an up draught.

Of course, in carrying out this system, it would be necessary to have on the main sewers in the lower parts of the town openings for the admission of air.

In most cases the outlets of sewers are under water for at least some part of the day, and without openings to admit air we could have no ventilation. Should it happen that the whole body of gas in the sewers was *heavier* than the outer air, then we should have a down draught, and the fresh air would enter at the chimney tops, and the gas be delivered at the air openings on the main sewers. Then we should be *accidentally* in exactly the position in which the present system *purposely* places us, viz., of having the gas delivered at street level.

But this case would so rarely occur that it need not alarm us. In most cases, the air of the sewers is sensibly warmer than the external air, owing, in no small degree, to the quantity of warm water which passes into them.

A case far more likely to occur, would be that a considerable proportion of the gas chimneys might have a down draught, while the rest had an up draught. But this would have no ill effect as the gas would still be conveyed away, and delivered at the top of some one chimney or another, and it matters little to A if his proportion of sewer gas is delivered at B's chimney or *vice versa.* In either case it is got rid of at a safe level.

Thirdly. The possibility that during summer, when part of the house fires are unlighted, the gas might find its way down the unoccupied chimney, and into some dwelling-room—this is known to occur occasionally with smoke, and might do so with gas. Undoubtedly this would be an evil, though not of very frequent occurrence. It could be met, however, by laying the "gas chimney" invariably alongside the kitchen chimney, which is always lighted while the house is occupied, and by a cowl arranged to deliver at the sides, or at a slightly lower level than the other chimney pots.

Fourthly. The objection of cost.

If the system be effectual, this is a very secondary consideration, while in all probability the substitution of earthenware for lead and metal in the main soil pipe would lead to a saving rather than an increase of cost.

The writer makes no claim to any priority of idea—no doubt the same plan has occurred to many besides himself—but he believes that the method is worth consideration, and that its discussion by Sanitary Engineers may be productive of benefit. This must be his apology for a somewhat crude and bald paper.

The CHAIRMAN in proposing a vote of thanks to Mr. Laws for his paper, said he should like to make a few remarks upon this subject. One suggestion of Mr. Laws was in opposition to what the speaker said he considered the right system of ventilating sewers. Mr. Laws advocated the ventilating of the sewers by means of houses, and suggested that a law should be made that every new house should have a ventilating shaft attached to it. It was well known now that the best practice was to keep the house independent of the main sewer. This was a question of principle, and the author of the paper they had just heard read recommended that that principle should be discarded. He should not refer to that matter further than to ask those who were interested in this subject to refer to his address of that morning, in which they would find allusion made to that point. He would only say that he did not approve of the suggestion made by Mr. Laws because he did not think it was in accordance with the best experience in sanitary engineering. Then upon another point, he remarked that people should not have a sewerage system arranged so that they had a deposit in that system which would involve anything dangerous. As a matter of principle, every thing should be avoided which was likely, in the slightest degree, to make collections of matter which might produce dangerous effects. Foul gas should not be produced and should not exist in the sewer at all. He gave a case where he said there was a serious outbreak of diphtheria. and he took an active part in endeavouring to discover the cause, and a meeting was held for this purpose. A great number of the residents complained of the foul state of the ventilators, and one of them actually plugged up the ventilators. This showed the amount of ignorance which existed in matters of this sort.

Mr. S. Alcock said he should be very sorry to adopt such a system as was recommended in that paper, for builders would be almost certain to make the ventilating shaft the means of letting the sewer gas all over the building. Speculative builders were not capable, in his opinion, of doing anything else. Ventilating shafts, might be the means of clearing sewers of the gas, but they would also be the means, if in the position recommended by the writer, of filling the houses with it. The sewer authority should take care to clear the sewers without attempting to enter upon private grounds. There was no doubt that the sewers should be kept free ; but he trusted the house would never be made the means of helping to ventilate the sewer. He had great pleasure in seconding the motion for a vote of thanks.

Mr. J. Lemon, C.E., said he quite endorsed the remarks of the previous speaker, that it was not desirable to ventilate the sewers by the means of pipes in houses. With regard to open gratings in public streets, this was a matter which was very much over-rated, and very much misunderstood. A gentleman once complained to him that the open grating was a nuisance. He answered that it was something better than that, because it was a nuisance detector. Open gratings showed people when their sewers were in an unsanitary state ; and he would go further and say that when there were proper discharges and proper gradients, this gas would not arise, and that gases only arose when the sewer was improperly constructed. The objections which were raised with regard to open gratings would not occur with properly constructed sewers.

Mr. Hubert Laws said that too great a stride was made when they stepped from an open ditch to a closed sewer. He considered that a perfectly open sewer with a smooth channel was preferable to a hermetically closed sewer ; this however was not practicable in populous places, for obvious reasons. That being his opinion, the Section would not be surprised to hear that he advocated that sewers should be as open as possible; that is to say, they should have perfectly open ventilating grates at short intervals, preferably in the main streets, where the foul air would be sooner dissipated and where children would be less likely to play. It seemed to him that it was a very desirable object, if sewer gas did exist, that it should escape in the open air, and not in the house. He quite agreed with the writer of the paper that the more openings the better, and that there should be openings up chimney stacks in addition to, but not in substitution for, the street ventilators; but the question which presented itself very seriously to him was the liability of the gas to get down the adjoining chimney.

Mr. D. Emptage said he could not agree with the plan proposed by Mr. Laws of carrying the sewer vent-shaft up inside the chimneys, as he considered there would be great risk that the gas would escape into the house, either through defective work, or by the means of an adjoining chimney. At the same time, he was of opinion that if every house had a separate ventilation for the sewers, carried to its top, a current of air would be introduced at the street gratings which would entirely remove the evil now so generally experienced. He gave an instance in which he said they had openings at each end of their drain and soil pipes, in order to induce a current of air through them. He contended that upright shafts to each house to act in communication with the street gratings was the only practical way of inducing a current of air through the sewers.

Mr. T. P. Barkas said that the gas, after rising up the pipes, which Mr. Laws had suggested would not merely be blown down the chimneys, but could enter also the bedroom windows and the attic windows. There was not only this evil to look for as the result of the adoption of the system proposed by the reader of the paper, but he foresaw at the same time that there would be practical difficulty as to ventilating the sewers by means of large shafts. Where there were miles of sewers it would take a great number of shafts to provide sufficient means of ventilation for all of them. The whole question was one of vital importance and well worthy of consideration. He questioned very much whether the owners of shafts would be willing to allow such a use of them as was proposed, and altogether he was in grave doubt as to whether the plan recommended was a desirable one to adopt. He was not quite sure whether it would not have been desirable to have kept up, as some gentleman had already suggested that morning, the system of open drains. That system certainly offered a very large number of means of escape for the effluvia. As regarded their city, he must say that they were very admirably situated as far as their sewers were concerned. He should be very sorry to dogmatise as to the best mode of ventilating sewers, but he was rather disposed to think that the mode recommended in the paper was one of the worst.

Professor F. de Chaumont, F.R.S., said that the only true system of properly ventilating sewers was by having every thing connected with them as open as possible. With reference to the proposal made in the paper to have shafts and furnaces for ventilating sewers, he thought that that had long ago been dealt with, and the idea exploded. The principle was employed in Sir Joshua Jebb's system of ventilation in the model prisons, such as that at Pentonville. From a careful examination which he had made some years ago, he came to the conclusion that the plan was inoperative, except in the immediate vicinity of the furnace. But it was only at Pentonville that even an attempt was made to carry it out completely,—for in one prison he had visited he found that although the furnace had been built for twenty-one years, the fire had not once been lighted. At Southampton, where the prison was on Jebb's principle, he asked a Town Councillor if he knew anything about the furnace, and he answered that he did not, and that he really did not know there was one in existence.

Mr. E. C. Robins, F.S.A., said that there was very great risk of gases being introduced into the house if this system of ventilation were adopted. He alluded to some very interesting experiments on the porousness of materials which had been made on this subject in Munich, and some growing out of his own practice. The ventilation by pipes carried up to 3 feet above the highest chimney stacks, fixed outside the house, was unobjectionable.

Captain R. T. Hildyard said the great thing was to see how the largest amount of ventilation was to be got in the least hurtful way. He advocated the use of gratings to ventilate sewers.

Mr. H. E. Armstrong, M.R.C.S., took up the discussion and said, that as regarded the subject of ventilating sewers by the means of shafts, he was not prepared to express an opinion on the matter. He did not think, however, that the owners of chimney shafts would like to allow their property to be used for the purpose proposed. As regarded the subject of open sewers, he thought that was a very difficult subject to deal with. He had at first differed from the views of the author of the paper, but he had thought the matter carefully over during the last few months, and he had had some painful experiences of illness caught by children through playing over street grates. He had come to the conclusion that it would be better to deliver sewer gas at a greater height from the ground, so that it might have a fair chance of being diluted. The chance of sewer gas being carried off over the chimneys was not great. He thought that advocating entirely open sewers was a retrograde proposal.

Mr. Balfour, C.E., said, from his experience of works in various places, the confinement of gases in sewers, and the consequent accumulation in quantity as well as concentrated virulence in quality, were the cause of complaints. By simply free and frequent outlets (say every 100 yards), the abundant diffusion by the entrance of fresh and exit of foul air, is found practically to be destruction and prevention of the otherwise dangerous cases, when confined and under pressure by insufficient or complex methods of ventilation. In various towns this has been unquestionably proved by chemical analysis of the sewer air as made before and after free ventilation. On this important point, now agitated in many towns and villages, I would quote the official regulations by Mr. Rawlinson, the Local Government Board Engineer-in-chief, who as truly said of him, "has the authority of an unequalled experience." He states, "There are many towns in which sewers are not ventilated, because the authorities refuse to have any open sewer ventilator at the street surface; this is a sad mistake, as a town having unventilated sewers, and house drains connected with them, must have disease in excess." Pipe shafts to be carried up house walls, from their limited capacity, and the density of the main sewer air are only of value for individual house drains. Smells, when really prevailing at sewer ventilators (and not as in many cases from mere sentiment and imagination) were valuable as notices for practical examination of the cause, such as the sewer silting, back gasses from branch drains, or perhaps neglect of the *débris* intercepting pans placed under the grated ventilators. Better far to receive notice in the milder form in the open thoroughfares than inside the dwellings, by fever and other serious cases of disease occurring.

Captain Douglas Galton, C.B., alluded to the means adopted in Memphis, in the United States of America, to ventilate the sewers, first by openings in the street drains, and, secondly, by having no trap between them and the house drains, but to carry the house sewer pipes up to the level of the roof. This, he said, answered there perfectly, but he pointed out that the distance was not very long to the outfall,—about a mile and a half, and sometimes nearly two miles; and, moreover, these were drains limited to the removal of house sewage, and in no sense sewers of deposit. He said he had always held the strongest possible opinion that it was extremely undesirable to use the house drain as a ventilator for the town sewer, and he had always advocated having a trap between the house drain and the sewer.

Mr. R. B. Grantham also took part in the discussion.

The vote of thanks was then passed unanimously.

Mr. W. G. Laws, C.E., in replying to the discussion, said he did not think that any rights which could be good for the public could be bad for the private individual. The whole question might be said to lie in a nut-shell—were they to ventilate at street level or above street level—which secured the greatest amount of safety to health? He thanked them for the vote they had passed.

Industrial Dwellings from a Sanitary point of View, by JOHN PRICE, Resident Agent, Newcastle-on-Tyne Industrial Dwellings' Company.

AT the outset I must express my great satisfaction that the President of the Institute has relieved me of the task of pointing out the many advantages resulting to the community from the erection of Improved Industrial Dwellings, as he has treated the subject in a far more able and convincing manner than I could attempt to do. It therefore will not be necessary for me to trespass much on your time, but I will merely offer a few remarks suggested by a lengthened experience in the management of such dwellings.

The recently issued report of the Parliamentary Committee on Artizans and Labourers' Dwellings, whilst it contains much valuable information relative to the cost and acquisition of sites for the purpose of erecting various blocks of dwellings for the working classes, throws but little light on the actual working of such undertakings, as but one of the witnesses examined before the Committee had lived in one of these blocks of dwellings, and was therefore able to speak practically of their merits or disadvantages. The opinions of one who has resided for twelve years in a large block of industrial dwellings, and has had daily experience of their working may not prove unacceptable.

I should be glad to be able to dispel the illusion which sometimes exists, that the working classes as a body are afflicted with but one idea regarding sanitary matters; the truth being, that as great a diversity of opinion exists amongst them as in any other section of the community, not only with regards to sanitary matters, but also on social, religious, and political subjects. During a thirty years intimate association with the working classes I have met with many persons who took an honest pride in keeping their homes and surroundings clean and healthy; I have also occasionally come in contact with others who seemed insensible to the virtues of cleanliness and the value of fresh air, and who, if allowed, would speedily have brought disease and the disastrous consequences which follow in its train not only on themselves but on their neighbours. This latter class will be found to be the persons who most loudly complain of the irksomeness of regulations necessarily devised for their own safety, which they endeavour to treat with contempt, and also try to persuade the thoughtless to follow their example.

The question as to whether the block plan of dwellings for the working classes, when under proper management, are as healthy as ordinary houses, is now satisfactorily set at rest by reliable evidence based on lengthened experience. The death-rate of the blocks of dwellings belonging to the London Improved Industrial Dwellings Company, of which Sir Sydney Waterlow is chairman, only averaged 16·4 per 1,000 during the year 1881, against 21·2 in the metropolis generally. When it is considered that this company has already provided house accommodation for about 20,000 persons, and is extending its operations annually, the information which it is able to afford is entitled to our respect.

The Peabody Trust, which has provided accommodation for about 12,000 persons in their various blocks of dwellings, exhibited an average death-rate of 17·22 for the year 1881, as against 21·2 in London generally.

The Metropolitan Association, which accommodates upwards of 6,000 persons in their various buildings, records a death-rate of 14·3 only for the year 1881.

The average death-rate of the block of buildings belonging to the Newcastle Improved Industrial Dwellings Company, which contains a population of about 500 persons, is still more favourable, as during the twelve months ending 30th June, 1882, only six deaths occurred in these buildings, whilst during the same period the births numbered 34; or an average death-rate of 12 in the 1,000, and a birth-rate of 68 in the 1,000. Since these buildings were opened there has been a total of 62 deaths and 162 births. The death-rate of the rest of the parish of All Saints', Newcastle (in which the above buildings are situate), was 22·2 in the 1,000 during the year 1881. The average death-rate of the Pandon group of houses which were adjacent, but now demolished, exceeded 40 in the 1,000. The results shown in the last-named block of buildings must be considered the more satisfactory when it is remembered that the majority of the tenants are labourers working on the Quayside or neighbourhood, few of whom earn more than 20s. weekly when fully employed. Other striking instances could be adduced of the low rate of mortality exhibited by populous blocks of workmen's dwellings, proving decisively that the healthiness of a given area does not always depend on the density of its population.

The evidence given before the Parliamentary Committee showed that the problem of how to provide healthy dwellings for the poorest class, at rents suitable to their means, had not yet been satisfactorily solved. Numbers of poor people have been turned out of their homes, and excellent dwellings erected on the site for which rents are asked that the poor cannot pay. They are thus driven to find accommodation elsewhere, better adapted to their pockets, though probably at the sacrifice of their health and comfort. We must, therefore, not forget that necessity, not choice, often compels the poor to herd together and diffuse the germs of disease throughout the community as a penalty or in retaliation for the treatment to which they are sometimes subjected.

The individuals and companies who have provided the various blocks of model dwellings now in existence should not be blamed hastily, because they cannot do impossibilities. Without some prospect of a satisfactory return for their investment, it would be difficult to find capitalists willing to provide half of the money required for the purpose, before the Government would lend the other half, and as the payment of the interest on the Government loan and the redemption of the capital forms a heavy drain on the revenue of most Companies, they naturally endeavour to obtain such rents as will enable them to discharge their liabilities, and afford a satisfactory return to their shareholders. Where the work has to be carried on on a sound commercial basis no other procedure can be expected, and the very poor must depend to some extent on philanthropic aid for better dwellings.

Industrial dwellings, to be a success, must possess certain requirements suited to the wants of the class for whom they are erected, the most important of which are convenient situation, and also convenient domestic arrangements, in which those vital essentials, fresh air, pure water, good drainage, and reasonable rents should meet with due recognition. Abundant evidence was furnished to the Parliamentary Committee that the working man will make many sacrifices for the great advantage of residing near his work, and I venture to state that the strongly expressed opinion of the London working men is thoroughly endorsed by his brethren in the country. Pictures of rural paradises, with their desirable attractions, soon lose their charm, when accompanied with a succession of lost quarters, the result of the cost and inconvenience of access. Model dwellings are, therefore, most appreciated by working men when placed near the scene of their daily labour. The arrangements most preferred are those which bring the fewest families or persons in contact with one another on a flat or landing. As a rule, the buildings should not exceed four stories in height; the stair-cases should be about four feet in width, and broken by short landings, lighted by large windows open to the external air; the window-sills should not be less than three feet from the floors for the safety of young children, and for the same reason well stair-cases should be avoided. The steps of the stairs should only have a 6-inch "rise," for the more easy accommodation of old people and young children; they should be fire-proof, and well lighted with gas on an evening. There should be a thick layer of deafening between the floors. The water-closets should be placed in an offshoot from the main building, opening on to each landing, and well ventilated by open windows and air bricks. The water-closet apparatus should be as simple and effective as possible. Patents depending upon the proper working of valves and ball-cocks should be avoided as the fruitful cause of trouble and expense; little reliance must be placed on their proper use by tenants where more than one family have access to them. I have seen excellent closets stopped up with cloths and all manner of earthenware and hardware, children of careless parents being the principal offenders; what is everybody's duty is often most neglected. It will be found most economical in large buildings of this class to appoint a person whose duty it should be to attend to the proper flushing of water-closets daily. I would suggest that there should be a large cistern under the roof (distinct from the cistern used for domestic purposes), a $\frac{3}{4}$-inch feed pipe should lead to each W.C., which should consist of a simple metal or earthenware pan, provided only with a tap, flushing rim, and plug, placed under the seat securely, and under the sole control of the attendant, who, by the necessary daily inspection, would detect any stoppage or injury to the fittings. The expense of such supervision would probably be soon saved in plumbers' bills. Of course the soil-pipes should be well ventilated above the roof of the building, and all drains and sinks should be properly trapped. The attendant on his daily rounds would also be able to see that these are kept in proper order. The dust-shaft, extending to the full height of the building, should have proper hoppers connected with it to prevent the dust coming from the lower or upper landings; a nuisance sometimes complained of in block dwellings. The wash-houses should be placed on the roof or in the yards, fitted with set pots and requisite conveniences. The soft water from the roofs should be stored in tanks for washing and domestic purposes—it will be much appreciated by sensible tenants, and save the water bill greatly.

The great desiderata of these large blocks of buildings is ample play-ground for the children, without which they play upon the stairs, and are often the cause of strife amongst neighbours. I know those who have experience in the matter may say that it is more easy to state what is desirable than what is practical. The enhanced value of land in all our large towns precludes any liberal investment on what appears so financially unremunerative as play-grounds, yet they are essential adjuncts wherever there is an infantile population. Mr. Powell, on behalf of the London Trades' Unions, enumerated before Sir Richard Cross's Committee certain objections which the working classes of London entertained against the earliest erected blocks of dwellings, amongst which was their barrack-like and uninviting appearance, and also their want of play-grounds for children. Recently these defects have been greatly remedied.

It has been admitted that many of the newly erected blocks of dwellings give no cause for complaint, and the prejudice which once existed against this class of buildings is rapidly dying away, as evinced by the unceasingly numerous applications for accommodation in them. With regard to the Newcastle Improved Industrial Dwellings, with which I am more immediately connected, they are now fully occupied, and as the rents are about 25 per cent. lower than the London Companies charge for similar accommodation, we may perhaps claim the credit of housing a larger proportion of the lowest-wage paid class of labourers, than are to be found in other blocks. The large room attached to the buildings, in which social re-unions of various kinds are frequently held, is another special feature which, I believe, has been productive of much good. Although the Company are not insensible to their imperfections of construction, they arise more from limited capital than from any indisposition to carry out what they know is desirable. The extraordinary low average death-rate of 12 in the 1,000, shewn by their buildings for the year ending 30th June, 1882, should be a significant testimony of the attention paid to sanitary matters, as it should also be of the value of such buildings to the community, a subject which was so well and exhaustively handled by the President of the Institute in his opening address.

I cannot resist this opportunity of expressing my share of the wide spread regret caused by the action of the Corporation of Newcastle in turning out hundreds of poor persons consequent on the New Street Improvement Scheme at the East-End, and making no provision for their proper housing. A few took refuge in our new buildings, but the majority crept into other places better adapted to their habits and means, though probably to the detriment of the public health. I think that sufficient evidence has been adduced as to the value of Industrial Dwellings to the community to commend them to the practical support of not only philanthropic individuals, but also of Corporations and public bodies generally.

The CHAIRMAN moved a vote of thanks for the paper.

Mr. DAGLISH said he had listened with very great pleasure and very great interest to the paper which had been read by Mr. Price. In his opinion a "resident director" should actually be on the spot, for he would take more interest in the welfare of the people who paid the rents, and he would be not merely a shareholder. The concern had not, he must say, been unsuccessful, for they paid a dividend of four per cent. some time ago. They had not paid anything lately for various reasons. This year he thought they had paid one, and he hoped that they always would do so in future. He must mention one point, and that was that as an Industrials Dwelling the Government now called upon them to pay inhabited house duty, which he considered a great abomination. Every tenant they had as a tenant was an inhabited householder, and it was hard upon them, he thought, that they should be made to pay £50 or £60 a-year for inhabited house duty because the Government chose to say that their building, containing very numerous tenants, was a house under one roof, instead of a number of houses occupied by tenants paying less than £20 a-year rent, the sum at which duty became levyable.

Captain DOUGLAS GALTON, C.B., said he was sure they had all listened with very great interest to the paper, and also to Mr. Daglish's speech. He remarked that, in his opinion, such papers as these were most valuable, because there was not the slightest doubt that the question before them was becoming one of the most absorbing interest. As regarded the question of the price of land, there was no doubt that it was one of immense difficulty. The Metropolitan Board of Works had, to some extent, assisted some of the Industrial Dwellings Companies in London by not putting the highest price upon the land. He thought that it would be really possible, in course of time, to have all houses converted into really good dwellings, in even the most crowded towns, provided the Corporation made up their minds it should be done. Of course it was possible to erect dwellings outside the towns for a certain number of those persons who were displaced by having their unsanitary dwellings destroyed; but there was a very early limit to that, because a very large number of that class of the population must live close to their work. He could only say that he would commend to the attention of all town authorities the importance of assisting private enterprise when the promoters were willing to devote themselves to the task of making improved industrial dwellings.

Mr. S. ALCOCK remarked that this was, in his opinion, one of the most important matters that had come before them, and he thought that, after all, they could only look upon industrial dwellings companies as pioneers of the way in which such dwellings ought to be provided. Unless it could be shown that these companies could provide dwellings which would give sufficient remuneration for the capital that persons invested in them, what they would be able to do would be infinitesimal: they would not succeed really in providing for the wants of the working classes generally. So far as Sunderland was concerned they had very advantageous dwellings for the working classes, consisting of cottages of one storey, self-contained, and having three or four rooms, at a rent of 4s. or 5s. per week. There were a good many points of view from which he thought this question might he looked at, but he believed that the sanitary question was not the most important, but that good sanitary dwellings would have a great tendency to exterminate the criminal classes.

Mr. J. Lemon, C.E., said that in the address they had heard from the President of the Section, the question was raised as to whether the erection of these dwellings did not pay in the long run, and whether the saving of life by the prevention of dirt and disease, of a large population, was not a source of wealth to the community generally. He himself had no doubt that this was a fact which could be easily and conclusively proved by statistics. The local authorities, he thought, were only doing their duty to the ratepayers when they consented to a loan for the carrying out of these works. He did not think that public companies could afford to pay any loss which was occasioned over the erection of these healthy dwellings, nor did he think it was right that they should do so. If these buildings were to be erected in the centres of towns, as it seemed necessary that they should be, he thought that the only way out of the difficulty was for the local authority to make some concessions to the private individual who might happen to have the enterprise to erect the buildings. They would be doing their duty to the ratepayers in so doing.

The vote of thanks was then passed.

SECTION III.

CHEMISTRY, METEOROLOGY AND GEOLOGY.

ADDRESS

By Arthur Mitchell, M.A., M.D., LL.D., F.R.S.E.,

PRESIDENT OF THE SECTION.

The special aim of this address is to show that the relations of weather to the distribution of deaths from certain diseases, that is, to the fatality of those diseases, has now been so definitely ascertained, in so far as regards this country, that no account of these diseases can be regarded as complete which fails to treat of those relations. In other words, the ascertained relations of weather to deaths from the diseases in question, must now be accepted as part of their known natural history. As regards certain diseases the facts have been analysed, sifted, and cross-questioned, with the result of showing that the relations between weather and deaths from those diseases are so steady as to be manifestly the outcome of an obedience to law. It also appears that what is now known to be true of the diseases which have been investigated with some fulness, will probably be found to be as true of many other diseases when they have been submitted to an equally pains-taking investigation.

This is the special aim of the address. All I desire is to show the *constancy* of the relations of weather to disease. It is with the *constancy*, not with the *characters*, of these relations that I wish to deal. Had I dealt with their characters and with the speculations which these fairly raise, I should probably have been followed with more ease and greater interest; but dry and difficult as my subject is, I am not without the hope that I may succeed in establishing my position.

Such a question as what are the relations of weather to deaths from particular causes can only be answered by statistics. But it is difficult, on looking at long columns of figures, to see what they teach; and when vast masses of figures are dealt with, as is the case in the research of which I am about to disclose one important result, it is practically impossible in an address like this to present the figures themselves in a way which would not be confusing.

It happens, however, that the figures can be presented graphically, so as instantly to exhibit what they teach; and such a presentation of them is seen on the numerous diagrams which hang on the wall.

Unless, however, the method of thus presenting numbers graphically is clearly understood, I shall not succeed in demonstrating what I wish to demonstrate.

The horizontal black line in each figure represents the mean weekly death-rate on an average of the fifty-two weeks in the year, or group of years under investigation, and it may of course have reference either to all the causes of death, or to deaths from some one cause. With this—the average weekly death-rate—the death-rate for each week separately is compared: and the difference above or below is calculated in percentages of the mean weekly death-rate for the whole period. When the percentage for any week is *plus*, the amount is marked, according to some adopted scale, on that one of the vertical lines which corresponds to the week in question, and above the mean line, of course. When, on the other hand, the percentage for any week is *minus*, a mark showing the amount, according to the same scale, is placed below the mean line on the vertical line representing that week. When the result for all the weeks is marked on the fifty-two vertical lines, the marks are joined by a line drawn through them, and we have then a curve sometimes above and sometimes below the mean line—showing at a glance the weeks in which the mortality was above or below the mean, and the measure of that excess or defect.

The relations of weather to disease have long occupied the attention of Mr. Alexander Buchan and myself. In our first efforts to ascertain those relations we dealt chiefly with the eight principal towns of Scotland, but it soon became apparent that the smallness of the population of these towns, the division of time into months instead of weeks which the Scottish Registrar General adopted in his returns, and the shortness of the period over which these returns extended, made Scotland unsuitable as an area from which the facts we needed could be gathered. We then turned to London, 1st, because it had an enormous population contained within an area so limited that it might be regarded as having one uniform climate during each of the seasons of the year, and 2nd, because it possessed full weekly returns of weather and of deaths from different diseases extending over a long series of years. Accordingly some six or eight years ago, we made a complete discussion of all the relevant facts for London for the thirty years from 1845 to 1874 inclusive, and we obtained, even for diseases which had a small total mortality, results which are expressed in these curves, shewing relations between weather and deaths from special diseases which we thought would turn out to have the value of constants.

I have already explained that if we know the deaths from any particular cause for each week of a long series of years, we can ascertain the average distribution of deaths from that cause over the different weeks of the year. When represented graphically, in the way I have described, the number thus obtained must yield a curve or figure of some kind. It may possibly be a straight line, or something approaching to one, which would mean that the average mortality from the cause in question for any one week was the same, or nearly the same, as that for every other week. On the figure or curve may be an irregularly serrated line—that is, the number of deaths in the different weeks may fluctuate irregularly, rising and falling frequently and without method. These results may occur either in the case of a disease which is highly mortiferous, or in the case of a disease which kills but few. In neither of the results should we have the expression of any seasonal influence on the progress of deaths from the cause in question.

But, on the other hand, the numbers may yield a curve or figure, which seems to be the outcome of some influence, which recurs periodically, and which causes the curve after it begins to fall to go on falling to a certain point, and in like manner after it begins to rise, to go on rising to a certain point.

When we get a curve of this kind, we are justified in regarding it as probably possessing significance and value. If it embodies the results of a large number of years, and deals with a population sufficiently great and sufficiently concentrated, we may almost safely treat it as a constant. In other words we are fairly safe in concluding (1) that deaths from that cause in the same community for shorter groups of years, or even for single years, would be distributed over the different seasons substantially in the same manner; and (2) that such divergencies as occurred would be affairs of degree and not of kind, and would answer to corresponding divergencies between the seasonal weather of the shorter groups of years and that of the long series of years.

That we are safe in doing this with regard to a large number of the causes of death has been placed beyond question. In

London, for instance, the curve of deaths from diseases of the respiratory organs, representing a mean of thirty years, is almost exactly the same as the curve representing the mean of any five or ten of the thirty years. It is, indeed, essentially the same as the curve for any one of the thirty years.

A like thing can be said regarding deaths from diseases of the abdominal organs, and perhaps also regarding deaths from diseases of the nervous centres.

But the steadiness which I desire to disclose, goes beyond the numbers which show the total deaths from a great class of diseases. It appears as decidedly and strikingly, when we deal separately with the numbers representing deaths from the special diseases which make up the class. Thus:—The curve of deaths from pneumonia has certain characters which distinguish it from the curve of deaths from bronchitis; and the dysenteric curve in like manner, has features which distinguish it from the diarrhœal curve. These distinguishing characters do not simply appear in the mean of the thirty years; they appear if we break up the thirty years into quinquennial or decennial periods. There is a kinship between the diseases which form the groups or classes of the Registrar General, but they are nevertheless in many respects distinctly differentiated from each other. That kinship shows itself also in the relations of weather to mortiferousness. For instance, speaking broadly, the homicidal tendencies of all diseases of the respiratory organs are strongest at one and the same season, and the same is true of diseases of the abdominal organs. The one class of diseases kills most in cold, and the other kills most in hot weather. But the special diseases which form the classes, though they show a substantial agreement, are nevertheless differentiated from each other by steady peculiarities in their relations to weather.

It may be confidently asserted that it never happens that the curve of deaths from diarrhœa assumes the characters of the curve of deaths from bronchitis, or *vice versâ*. It would never be possible to mistake the one curve for the other. This is equally true of the curves of deaths from a great many other causes, which are as decidedly and as unfailingly characteristic. These statements may perhaps appear strong and novel, but they are beyond question correct. Their accuracy has been fully proved —has been demonstrated, I may safely say. I make them now merely as a preparation for the further illustration which I am about to adduce, of the steadiness of the relation of weather to deaths from particular causes. All that I have asserted may be quite true of such causes of death as bronchitis, pneumonia, diarrhœa, and dysentery, and yet may be quite untrue of such causes of death as small-pox and scarlet fever. These last occur as epidemics. They kill large numbers in some years and comparatively few in others. It seems, therefore, almost improbable that deaths from them can exhibit a steady obedience to seasonal influences. With regard to them we are almost prepared to expect, that what may be true of a thirty years' period will be found to differ *in toto* from what shorter periods show; and that consequently we cannot construct curves for them, which will have the value and dignity of constants. This I think is what would be naturally expected, and I proceed now to show how far the facts answer the expectation.

First then as regards small-pox:—The mean curve of death from this disease for thirty years is a simple curve, and shows a mortality above the average from Christmas to the end of June, and a mortality below the average from the beginning of July to Christmas.

Now during the thirty years there were nine distinct small-pox epidemics, but the epidemic from the autumn of 1870 to the end of July, 1872, was greatly more severe than any other. Before and after that time the deaths from small-pox on no occasion exceeded seventy-one for any week; but in 1871, during the three last weeks of April and the first week of May, the deaths averaged 273 a week, rising to 288 in the first week of May. If we take away the deaths which occurred during this abnormally high epidemic, and average what remains, we obtain a result which shows that the maximum death-rate is during the first seven weeks of the year, and the minimum in September and October. The withdrawal, therefore, of the figures yielded by the remarkable epidemic of 1870–72 does not alter the character of the curve for the whole period, except in reducing its sensitiveness.

In order to see how far the leading characteristics of the small-pox curve maintain themselves during the whole thirty years' period, a table was prepared showing for each of the five-year periods, from 1840 to 1874, the number of deaths which occurred during the four weeks of January and the four weeks of September, being the four consecutive weeks which give the highest, and the four which give the lowest averages respectively in the curve for the whole period. The result is, that the table shows that during each of the seven quinquenniads, the excess of deaths in January as compared with September was constant —the excess varying from 21 to 164 per cent., the average excess being 72 per cent.

The constancy of these results in the case of a disease like small-pox, which is commonly thought to have no steady relation to season, is remarkable.

So far, then, the cross-questioning or analysis of the mass of facts embodied in the curve, which was treated as revealing a constant, confirms the propriety of so treating it.

But the recent occurrence of an epidemic of small-pox in London—in 1881—the deaths from which are not included in the series of years referred to, namely from 1840 to 1874, affords an opportunity of applying another test, and a severe one. We shall deal with a single year, and that the year of an epidemic, and ask whether, during that short and exceptional period, the progress of the deaths from small-pox was so controlled by the seasons as to be above and below the mean during the weeks when they are above and below the mean in the thirty years' curve.

The answer to this question is that the curve of constancy is above the mean from the beginning of January to the end of June, the maximum being in the last week of May, and the minimum in the last week of September. There is a secondary maximum in January. The curve is below the mean from July to January.

Turning now to the curve of the 1881 epidemic, it appears that almost exactly the same words describe it. During this epidemic the mortality was above the mean from the middle of January to the middle of July, and below it for the rest of the year. The only difference thus is that the curve of the epidemic was a fortnight later of rising above its mean, and a fortnight later of falling below it again. The absolute maxima of both curves occur at the same time, that is, in the last week of May.

The fact that the departures above and below the mean are greater in the epidemic curve than in the curve of constancy, constitutes a mere difference in degree, not in kind. In both it is the same season which intensifies the mortiferousness of small-pox. The application of this further test, therefore, gives additional support to the value of the small-pox constancy curve, and shows it to be a feature in the natural history of that disease, which cannot properly be ignored, and the knowledge of which may prove of practical value.

I have now to show how the facts stand in regard to scarlet fever; and here I am able to present a still more minute analysis of the deaths. During the thirty-five years, from 1840 to 1875, there occurred six epidemics of this disease in London, reaching their absolute maxima of fatality in 1844, 1848, 1854, 1859, 1863, and 1870. The thirty-five years therefore, naturally break themselves up into six periods, each including an epidemic—the first from 1841 to 1846, the second from 1846 to 1851, the third from 1851 to 1857, the fourth from 1857 to

1861, the fifth from 1861 to 1867, and the sixth from 1867 to 1873. The year at the beginning, and the two years at the end of the period are not dealt with—the first representing a period falling to its minimum, and the second a period rising to its maximum—the last being in fact an epidemic then prevailing in London, and not at an end.

The deaths occurring in each of these six periods of five, five, six, four, six, and six years have been dealt with separately, and six curves have been constructed, showing the mean yearly deaths from week to week for each period. It will be at once seen that the curves for all the six short periods are essentially the same as the curve for the long period. They are below the line of mean mortality during the same period of the year, and above it during the same period. In rising from the low period to the high period they all cross the mean, either in the same week, or in the week before or after—towards the end of August or beginning of September; and nearly as regularly do they pass out of the high period back again into the low period in the month of January.

The figures for the individual years have not yet been separately and fully examined, but it has been ascertained that the same seasonal influence over the distribution of deaths from scarlet fever runs through them. If, for instance, we prepare a table showing the deaths from scarlatina in each week of each of the thirty-five years, and write those numbers in red which are decidedly above the mean weekly death-rate for the year in which they appear, those in blue which are decidedly below, and those in black which are near the mean, we get a table with three great columns of figures in red, blue, and black. The columns are not absolutely straight, but they are sufficiently so to demonstrate the unfailing operation of some seasonal influence controlling the distribution of the deaths from scarlet fever over the weeks of the year.

I have hitherto been speaking only of deaths in London, which was selected, for the reasons I have given, as the place affording the best materials for this research. But when it was found that the London data disclosed this striking constancy in the scarlet fever curve, it was naturally asked whether this might not be something peculiar to London, and whether the same distribution of deaths from scarlet fever over the weeks of the year would be found to occur in other localities. Accordingly, the facts for twenty-seven towns in England, Scotland, and Ireland have been examined. The smallness of many of these towns, the shortness of the period during which the registration of deaths with their causes has been in operation, and in some instances doubts as to the trustworthiness of the registration—all tend to weaken the value of curves based on the data, which these localities supply. But in spite of these drawbacks, the general results strongly corroborate all that has been said about the constancy of the scarlet fever curve in London, and show it to be a constant not for London only but for Great Britain and Ireland. The curves for Norwich, Bristol, Wolverhampton, Birmingham, Leicester, Liverpool, Manchester, Salford, Oldham, Newcastle, Belfast, Dublin, Glasgow, Edinburgh, Dundee, Aberdeen, Greenock, Paisley, Leith, and Perth are essentially identical with the curve for London. The varying sensitiveness, that is, the extent of the departures from the mean, above and below it, has little or nothing to do with the exact point now under notice, which is the influence of weather on the mortiferousness of scarlet fever, and not the greater or less prevalence of the disease in different localities.

A few of the curves,—very few,—those, for instance, for Hull and Sheffield, show a considerable departure from the characters of the London constant. I cannot explain these rare exceptions, but I have little doubt the explanation will disclose itself as the research goes on. In the meantime, persons accustomed to statistical inquiries will see in them nothing more than the exceptions which prove the rule, and which show that the broad results are not the outcome of any special way of handling the figures.

Turning now to the London curve of constancy for hooping cough, we find that it is almost the opposite of that for scarlet fever. This disease kills by preference from the middle of December to the middle of June, and has its maximum of destructiveness in February, March, and April. During the other months of the year it is less lethal, being least fatal to life in September and October.

This is what the curve for thirty years shows. But if we split up the period into six quinquenniads, will the figures for each of the five-year periods show the same or a similar distribution of deaths from hooping cough over the weeks of the year? This has been done, and the results disclose not merely a similar but an almost identical correspondence with the curve of constancy. It would not, indeed, be easy to fancy the outcome of a research better entitled to be called a demonstration than that which is furnished by these analyses of the London curves for small-pox, scarlet fever, and hooping cough.

But, again, as regards hooping cough, it may be asked whether the distribution of deaths over the year, which the London curve discloses, is not something peculiar to London. In order to answer this a set of curves has been constructed, which show the distribution of deaths from hooping cough over the weeks of the year for twenty-six towns in England, Scotland, and Ireland. It appears that what happens in eight-tenths of these is substantially the same as that which happens in London. The exceptions are few, and, in view of the circumstances affecting the data supplied by small towns, not important.

I hope no one will require that I shall show what practical advantages have been, or will be, conferred on mankind by these researches. In making them we did not concern ourselves in the least with that consideration, believing that additions to knowledge must always prove beneficial—though the time and the way, the when and the how, it may not be easy or possible to see and predict.

It so happens, however, that in these researches into the relations of weather to health and disease, there are already many indications of a practical utility.

To some of these indications I shall briefly allude, because they happen at the same time to illustrate further that constancy to which I have been continually making reference.

For instance, the London thirty years' curve for diarrhœa is very striking. It begins to rise rapidly above its mean in the end of June, and by the end of June and beginning of July is 300 per cent. above its mean. From this point it falls nearly as rapidly as it rose, and gets again below its mean in the middle of September.

The diarrhœal curve for each one of the thirty years is essentially the same in its character. So also is the diarrhœal curve for all the other towns in England and Scotland, and also for the whole of these countries, including both urban and rural districts.

Notwithstanding this general agreement there are differences. There are differences, too, in London, and in every other locality, between one year and another. No two years and no two places are absolutely the same. Though there may be a substantial and essential agreement, there is not an absolute agreement, and the question naturally arises :—Are these differences between the curve of constancy for London and the curve for particular single years in London, or between the constancy curve for London and the curve for other localities, merely differences of degree; or do they answer to corresponding differences of weather; and if so, to which of the elements of weather do they exhibit an obedience?

Little has yet been done in the way of answering this large question, but something has been done. As regards diarrhœa, for instance, temperature is commonly believed to be the element of weather of greatest potency. In this country, when the mean temperature of a week reaches 55°, the deaths from diarrhœa begin to rise, but the diarrhœal curve is not raised in an equal degree by every additional degree of temperature above 55°. It is seen, indeed, that a rise from 55° to 60° has a less effect than a rise from 60° to 65°, and still less than a rise from 65° to 70°. It may eventually be possible to determine for different localities the progressive rate at which each degree of mean weekly temperature above 55° raises the death-rate from diarrhœa, but as yet the analysis of the data has not been carried sufficiently far to give any indication of this.

Some light, however, may be thrown on the influence of temperature in shaping the diarrhœal curve by examining the facts relating to any three years included in the thirty years, one of which shewed a death-rate from diarrhœa running an average course, another a diarrhœal death-rate considerably above the average at its maximum, and the third showing a diarrhœal death-rate below the average at its maximum. Three such years occur consecutively from 1859 to 1861 inclusive, so that the data or numbers relate to a period which could not have been materially influenced by changes in social conditions or sanitary arrangements.

For each year the deaths from diarrhœa per 1,000 of the corrected population have been calculated for each week, and the results tabulated. In 1859 the rise in the hot months is highest and earliest; in 1861 it is lower and later; and in 1860 still lower and still later. All three curves, however, are substantially the same in character. They merely differ in degree or intensity. They all show a marked, though not an equally marked, period of maximum fatality from diarrhœa in July, August, and September.

I now proceed to compare these curves with the temperature curves of London for the same years. It appears from them that in 1859 the summer heat was greatest and earliest; in 1861 lower and later; and in 1860 lower and later still. In other words the divergencies between the two sets of curves are close, complete and direct in their character. That is:—With a greater and earlier summer heat, we have a greater and earlier increase of mortality from diarrhœa; and with a lower and later summer heat, we have a less and later increase of the deaths from diarrhœa; and with a still lower and later summer heat, we have a still less and later increase of mortality from bowel complaints.

Such divergencies therefore, from the thirty years diarrhœal curve, as we see here, are clearly of the nature of the exceptions which prove a rule—being, when thoroughly sifted and examined, in real accord with the rule.

I have alluded in this address to classes of disease as well as to special diseases; and I have indicated that weather generally affects the different members of the classes in much the same way. The curves for thrush, tubes mesenterica, enteritis, jaundice, etc., are all of the same character as the curves for diarrhœa and dysentery, though less pronounced. All these diseases kill preferentially in hot weather, and they are all diseases of the abdominal viscera. There is not one disease of these viscera which kills by preference in cold weather. They all reap their harvest in hot weather. So that if we find a disease causing death by preference in the hot weather of this country, enough is now known to justify us in concluding that the disease in question is probably one which involves an abdominal organ. In this way the researches I have been dealing with become an aid, by suggestion or corroboration in pathological enquiries. The deaths from plague, for instance, exhibit in an emphatic manner the diarrhœal curve—in so clear and emphatic a way that it is difficult to resist the belief that the great plague, and the historical plagues of London generally, were of the nature of cholera, and not of the nature of typhus.

Again, the curve of deaths from bronchitis is more or less closely repeated in the curves for asthma, pneumonia, laryngitis, pleurisy, and croup. In other words, the diseases of the respiratory organs show one result of weather, though with varying force and modifications of character—cold always increases their deadliness. They all do their dismal harvesting in the dead of winter.

In like manner curves for diseases of the nervous system have much in common. They could not be mistaken for curves showing deaths from diseases of the respiratory or abdominal organs. They are most fatal in cold and dry weather. Like other diseases, they kill all the year round, but their favourite time for killing is late spring.

These three groups include a large number of the diseases given in the Tables of the Registrar General.

There are diseases, however, outside of these groups, between which a relationship has been accepted by many—as, for instance, between erysipelas and puerperal fever—and it so happens that the curves for these diseases tend to give support to the idea of such a relationship.

The prolongation of the high mortality from hooping-cough to the end of May differentiates it from the other curves for diseases of the respiratory organs, and gives it a combination of the characters of the nervous and the respiratory curves, to which it seems entitled.

In the case of gout, too, this nervous feature appears with suggestiveness, and perhaps explains why the active gouty inflammation does not pass into suppuration, as other similar active inflammations so frequently do.

When we find a curve taking the strong shape of the diarrhœal curve, may we not correctly speak of it as revealing an annual epidemic? I go further and ask whether there is not for every disease something of the nature of an annual epidemic? It appears to me that there are reasons for answering this question in the affirmative. The thing which we call an epidemic of scarlet fever, when minutely examined turns out to be simply a great intensification of what is an annually recurring feature in the natural history of that disease. It has been shown that the epidemic does not transfer the maximum mortality from the end of the year to the beginning. It merely intensifies the normal rise. So with diarrhœa. The deaths from that disease in 1859 were vastly in excess of the deaths from it in 1860. In other words, there was then an epidemic of fatal bowel complaint, but the distribution of the deaths over the year was essentially the same as that for 1860, and for that of any of the thirty years included in the discussion.

Even with small-pox, which we commonly regard as uninfluenced by weather, I have shown that the epidemic of 1881 left the curve for the year unaffected except in intensity. That epidemic may be fairly enough regarded as nothing more than a great increase of the normal annually-recurring destructiveness of the disease. It was nothing more than an exceptionally rich crop reaped at the usual time.

It was only natural and reasonable, therefore, for a medical friend of mine when, in conversation about a prevailing epidemic of scarlet fever, he was asked whether he thought it likely that it had reached its climax, to get up and turn to the scarlet fever curve for the answer. On examining that curve and the published weekly returns of deaths, he said that the decline of the disease had, in his belief, commenced, and he turned out to be right.

If these views are correct something further seems to follow. When scarlet fever breaks out in a small town or village, and steadily acquires more and more force, attention becomes directed to the insanitary state of the locality. Inspections by health officers follow, and effect is promptly given to the recommendations they make. The epidemic abates and the results are announced as an evidence of what sanitary science can accomplish; but am I not entitled to ask if in reality anything more has taken place than the decline of the epidemic at nature's appointed time—the ending of an exceptionally rich annual harvest. The sanitary measures adopted may have accelerated the decline;

but we are bound to bear in mind that without them it would probably have come at the time it did come.

Professor F. de Chaumont, F.R.S., remarked that they must have all listened with the greatest pleasure to the extremely eloquent address of Dr. Mitchell. His name was so well known that the excellence of his address could have surprised none of them. Nevertheless the address and the facts which the President had laid before them, showed the wonderful constancy of the laws which governed the career of this world, and suggested many reflections, teaching, particularly, the lesson of humility. The address warned them, too, not to plume themselves too much upon the success of their efforts, and pointed out that they might be only aiding, in a very small degree, events which would occur in the ordinary course of time. Thoughts such as these must necessarily arise from a study of this kind, and an address such as this brought every part of a question before them in a much more graphic and distinct manner than they could obtain by merely reading, for instance, the descriptions of epidemics. The address they had heard corroborated the manner in which true science was progressing, by pointing out that what people were in the habit of calling unusual epidemics were merely the ordinary course of affairs. When he was a student it was urged that physiology and pathology were totally different things,—the one a science of living bodies in health, and the other of living objects in disease. Now, of course, it was well known that there was only one science of living bodies, and those that were called pathological conditions were only physiological ones exaggerated. He was sure he should meet their approval when he said that if the Congress had had no other outcome than this address, those who had travelled many miles to attend at Newcastle would be amply repaid for assembling there. He concluded by proposing that a hearty vote of thanks should be accorded to Dr. Mitchell for his address.

Mr. H. E. Armstrong, M.R.C.S, said he had great pleasure in seconding the motion. He had for many years taken a deep interest in the question with which the President had dealt in his address. Dr. Mitchell had examined the subject more broadly than he (the speaker), as an Officer of Health, could do, but the general results expressed in the paper corresponded with his own particular experience in Newcastle. With regard to small-pox, the audience must have been very much struck with the startling results which had been put before them. Sydenham's observations upon this subject were very striking. Epidemics of small-pox in his day frequently lasted two years; they gained greatest intensity in summer, and finally disappeared on the approach of the second winter. The worst were those which commenced in the early part of the year. The paper they had heard was undoubtedly a most valuable one, and it gave him great pleasure to second the vote of thanks.

Captain DOUGLAS GALTON, C.B., said he was sure they would carry by acclamation a vote of thanks to Dr. Mitchell for his most interesting and valuable opening address.

The vote was then accorded by acclamation.

Dr. A. MITCHELL thanked the Section for the vote they had accorded him, and for having listened so attentively to what he had said. He was at first afraid that his address would prove uninteresting, being so statistical in its character.

On "The Influence of Minute Suspended Matter on Health; its Detection, Collection, and Examination," by H. C. BARTLETT, Ph.D., F.C.S.

THE almost universal belief that health is influenced in a high degree by the air we breathe, and by the fluids we drink, or take in combination with solid food, is the reasonable result of the accumulated experience of all classes of people, extending from the earliest times to the present moment. It is no argument to the contrary to repeat the late Sir William Fergusson's silly sneer against science, to the effect that he did not greatly care about the quality of drinking water so long as it was to be obtained in abundance. Nor does it prove that nauseous and offensive trades are devoid of danger to the neighbours because it can be shown that some or perhaps many of the workpeople engaged do not apparently suffer directly from the unsavory emanations among which they pass the greater portion of their time.

We know that many of the noxious matters, against which we have to contend, are in a soluble form, as is evidenced in the nitrogenous, albuminoid, or ammoniacal constituents of some of the clearest filtered water; and the presence of copper, lead, or other poisonous metals, or metallic salts in drinking water, is almost invariably detected in solution. In the same manner, pollutions of the air are frequently diffused in a gaseous form, and require great delicacy of chemical investigation to estimate the relative quantities in which the gases may be taken up by the atmosphere, and still more so to ascertain in what proportions such gases must be deemed distinctly injurious to health and life when breathed through the lungs of the strongest or the more delicate of humanity.

We have more than thirty years' experience to confirm Dr. Angus Smith's experiments as to the usual amount of carbonic acid in the air of healthy towns, namely, 38 parts in 100,000. When this quantity is doubled, or quadrupled, as it may be, according to my experiments, in dense fogs, or in not very crowded school-rooms, and this increase is the result of the respiration of men and animals, together with the imperfect combustion of much illuminating gas and coal, the direct effects are unmistakable. Persons constantly breathing such contaminated air suffer from headache, depression, and want of appetite; become pale and dejected, and prove their lowered condition of vitality by falling an easy prey to all kinds of epidemic disease. But if the carbonic acid in the air breathed is not accompanied with other products of respiration, or of imperfect combustion, and is taken into the lungs diluted only by pure air, as is frequently found in the bottling of aërated waters, then it is doubtful how much increase of the proportion of carbonic acid to the air breathed may be habitually inspired with impunity. I can only give my own testimony to the fact that I have examined the air of breweries, soda water factories, and other places where pure carbonic acid mixes with the air in more than twenty times the proportions I have mentioned, and no ill effects of living in such an atmosphere have hitherto been proved to ensue.

The question then arises whether the poisonous effect of carbonic acid in conjunction with other matters given off by the exhalation from the breath of many persons in confined spaces, such as theatres, together with the by-products of imperfect combustion of coal gas, are due to the combination of other gaseous products. If so, the chemical analysis of the atmosphere of crowded theatres points chiefly to carburetted hydrogen, and the vapours of sulphur, either as sulphuretted hydrogen, bi-sulphide of carbon or as sulphurous acid gas. But these, in the quantities shown by analysis, do not certainly account for the toxic influence, for men labouring in gas works breathe without loss of health the sulphur gases, carburetted hydrogen, and carbonic acid in the air, to an extent far beyond the proportion in which these gases are found in the atmosphere of the most heated and crowded theatre. I have therefore been forced to the conclusion that the serious and even dangerous effects of bad ventilation must be, and are, mainly due to matters carried in the air which are not in a gaseous form, and may be found suspended as minute particles.

For many years it has been ascertained that solid particles of matter, either inorganic or organic, living or dead, are suspended in the air. Practically, a collection of these same particles may be found, usually, also, in suspension, in almost all drinking water open to the air. Absurd discoveries have been not unfrequently announced, by which the so-called floating disease germs have been written about, and the public mind, eager to take up sensational impressions, has been scared and unnerved with notions of blight and minute insect flights carrying with them the seeds of dreadful pestilence, as if that were the peculiar function of certain kinds of migratory insects. Before taking the responsibility of again rousing an undue interest in the subject of aëroscopy, I am anxious to assert, as forcibly as possible, the difference in the evidence I have obtained of the microscopic particles found in contaminated air and water, from the inspiration and ingestion of which lowered vitality and specific diseases have resulted, as contrasted with the absolute want of proof that any of these particles are disease germs in themselves.

I am equally desirous to point out that the balance of evidence actually is in favour of some epidemic diseases being carried and widely spread by clouds of insect life, travelling from country to country, usually from east to west, over a tolerably well defined area in which alone the insect flights have been observed. Scientific opinion is also fairly agreed that many contagious diseases are communicated directly from person to person by flies, and possibly by other insects, resting on the sufferers, taking with them the *contagium morbi* and leaving with it the reproduced disease on the skin or epithelium of the next one, two, or more persons on whom the insects may alight.

We know the desquamation of minute particles of skin in scarlatina does carry the contagium, and convey the disease to healthy persons, even after lying dormant for a period of more than twelve months, and that such minute particles may be retained and carried by the improper keeping of books or articles of clothing used in the sick room. The careful examination of flies caught in hospitals confirms the statement that portions of epidermis, epithelial cells, and pus corpucles, have been found adhering to the *antennæ*, the *proboscis*, and the *tarsi*. If, then, the particles of dead skin retain the *materies morbi*, and the flies convey the particles of skin, it is not necessary to believe with my venerable medical acquaintance, who declares that if scarlatina should ever make its way to the sea-side resort of which he is the ornament, the bare possibility of which he is sceptical, it can only be by the flies taking the disease themselves at the adjacent but opposition watering place, and coming over to communicate it in the delirium preceding suppressed eruption.

I have drawn attention to the possibility of propagating, and perhaps perpetuating, contagious diseases by the carriage of minute particles of skin, or other *dejecta*, long ago thrown off from patients since recovered from the disease. It would be an advance if we could recognise from the appearance of the particles so thrown off the difference between those likely to carry contagion and those which are effete and harmless. We could then devote our study to the former, and, perhaps, eventually detect the actual morbific matter. But this is not yet demonstrable, and we may waste a life-time in the microscopical and chemical examination of desquamations which, although coming direct from persons suffering from contagious disease, may not be imbued with the slightest trace of the specific disease germinal matter, or the germinal matter may be in such a condition as to be dormant at the time of examination, and be then unrecognisable. I have, therefore, given up for the meantime the investigation of specific disease contagium, and devoted more time to the general effects of floating particles on health. In 1870, my friend, Dr. Maddox, collected upon glass plates moistened with glycerine, the floating particles ascending from the sewer gratings, and carried out a most instructive series of microphotographs, from which much might have been observed if they had been preserved for examination under the present high powers of the microscope with the illumination now afforded. This is, unfortunately, a great loss to all investigators, as more than six months were laboriously spent, under conditions of no small danger, in obtaining the original specimens at a time of a severe cholera outbreak; but the specimens and photographs were wiped off the plates, and nothing remained but to proceed to collect a fresh series to work upon.

At first I was impressed with the value of Dr. Maddox's aëroscopic method of collection, and wherever I found a frequent bad smell in my neighbourhood, either from the sewers or drains, or from dustholes, or from the holes of rats and mice in the floors or paved yards, there I exposed my glycerine-covered slides and submitted them to the most careful examination under a twenty-fifth power. I will not recount my own disappointment in finding nothing of interest to me beyond various inorganic and mineral matter, crystals, and organic colloid matter, grains of pollen, and minute germs of fungi, microphytes, and monads. Nothing, in fact, to be specially connected in any way with the bad smells, which are so invariably associated in our minds with unwholesome air, bad drainage, sewer gases, want of ventilation, rapid tainting, and putrifaction of all articles of food in the immediate vicinity, and the indescribable, but well recognised effluvia which attend the combination of many of the foregoing, and are classed by practical and well informed Inspectors of Nuisances as "insanitary stinks, requiring disinfection."

Exposing one of my plates over a gully hole in the shade, on one occasion, I observed a pencil of sunshine, accidentally reflected from a polished brass plate, throw a brilliant light over the gentle current rising and impinging, as I thought, upon the moistened surface. Thousands of glistening flecks and motes played in that unsavory stream of air, but on approaching the surface of the moistened plate, the current of air, or, certainly that portion of it with the dazzling particles dancing in the sunbeam, divided itself and passed away, as if repelled by negative electricity. Was it possible, I asked myself, that the more minute particles carried by the sewer gases might evade being caught in the glycerine by their very lightness of suspension in air? This only partial glimpse of the truth, as I have since ascertained, induced me to seek some other method of collection. I next attempted to obtain my specimens by filtering the air through long filters of cotton wool, as was suggested by Deusch and Schrœder, who found that flesh did not decompose when no air surrounded it, except that passed through a sufficient length of this material. Again difficulties beset me, for while succeeding probably in intercepting most, if not all, the floating particles, the crop of minute particles given off from the cotton wool itself by shaking, completely covered up and masked those I was in search of by an *embarras de richesse.*

I forget by whom the idea was originated that gun cotton teazed out into wool might be used to filter out the suspended particles of air, but it was after Mr. Crooks had used ordinary cotton wool in his experiments on the cattle plague, whereby he was satisfied that the poison or virus suspended in the breath of the cattle was obstructed and retained by the wool. Dr. Lionel Beale submitted the impregnated cotton wool to the highest powers of the microscope with similarly negative results to my own. The ingenious notion of substituting nitrated cotton (gun cotton) for ordinary cotton wool was valid so far as this prepared cotton may be dissolved in ether, leaving the extraneous matter not soluble in ether free from the cloud of cotton particles; but here again I found certain of the most interesting of the minute forms, sometimes to be obtained, were deprived of their individuality by the fatty contents being abstracted by the ether, and the dry sarcode left no longer worthy of investigation.

Professor Tyndall having conclusively proved that a long filter of cotton wool so purified the air from floating particles that not only meat and other easily putrescible matters were kept indefinitely from putrefaction, but that a pencil of the electric light, admitted to illuminate a portion of a jar of purified air, showed no floating particles. Here was a truth again and again proved by experiment. No floating particles, no decomposition or putrefaction of articles prone to putrescence, so long as the air in which they are immersed is effectually filtered. This affords so important and conclusive an argument that decomposition and putrefaction are mainly caused by the floating particles which may be removed from air, and which are so largely present in all air which has not been filtered through cotton wool, that I was extremely unwilling to give up the hope of examining the particles thus filtered out. All experiments to isolate the particles from those of the cotton failed, and it was not until then that I thought of using the peculiar and beautiful waste product of the smelting furnace, slag-wool.

It is necessary to interpolate a reason for not being content with taking a specimen or sample of the air to be examined, and allowing the floating particles to subside by long standing in a perfectly quiescent state. Professor Tyndall thought it advisable to prove that this subsidence does take place if the air in the vessel is kept quite quiet long enough. This is the case, and the particles so deposited may be classed as to lightness by remarking that the slightest electrical attraction to the sides of the glass cone, in which the experiment was made, was enough to hold to the upper portion of the side the lighter particles, others in gradation of gravity being deposited lower, with the most weighty at the bottom.

But I have found, by the electric pencil of light, floating particles in suspension many days after perfect quiescence was obtained, and these I have since found to be the most interesting of all, being the minute living germs of animal or vegetable life, which sometimes perish or become themselves decomposed before they can be deposited by subsidence.

Hence I was induced to endeavour to filter out the minute floating germs and other matters from the air by the use of slag-wool, so as to obtain my specimens as quickly as possible, to prevent the premature death and decomposition of the more delicate of the organisms.

The great importance of rapidly collecting and examining the floating particles, is shown by the fact that in most drawings and micro-photographs of pus corpuscles, there are depicted as sharply defined spheroids enveloped in what may be termed stout cell membrane. But these pus corpuscles are of comparatively little interest when found in that condition, as they are the dead corpuscles, from which fresh pus cannot be reproduced either by contact or innoculation.

In no instance have I found a living pus corpuscle of clearly marked round form; on the contrary, the vitality of the cell is shown by numbers of excrescences or protrusions from the cell-wall, which is of extreme pliability and delicacy, and in these protrusions there is a constant movement, elongating and extruding from time to time from the parent cell, or apparently shrinking back almost entirely within its circumference. Very careful and continued investigation proves that these excrescences become in time detached from the parent cell, and if they find suitable nourishment from the surroundings to which they may be removed, they become true pus corpuscles and throw off other excrescences so as to multiply and spread the pus in or upon moist tissue, so as to indicate what is known as inflammation.

Inflammation of tissue cannot be said to be a specific disease in the sense that scarlatina or small-pox are specific diseases, yet it is probable that inflammation is never produced without the specific formation of pus cells, and it is certain that the introduction of living pus cells either by contact or inoculation will reproduce pus and inflammation in or upon tissues which would not of themselves at that time produce pus corpuscles or become similarly inflamed without local injury or smart irritation.

The condition, therefore, which is essential in the examination of all suspicious floating particles, either in air or in water, is they should be collected as rapidly as possible and investigated immediately, if we are to distinguish those in active vitality from the dried up or dormant, or from the dead and effete.

In using the slag-wool for the purpose of collecting floating particles from air or water, I first heat it to about 600° Fahr., and retain it at that temperature for an hour or more. I find no organic matter remains after this exposure to heat, and the inorganic ash can easily be shaken off the surface of the wool so as not to interfere with the fresh particles it is desired to examine.

A perfectly clean dry tube is packed with a long filter of the previously heated slag-wool, and the air or water drawn through the tube in any required quantity, either by an aspirator of known dimensions, or a suitable pump. When observing the minute particles filtered from the air I merely tap the end of the tube smartly against the glass microscope slide, cover the central portion with the thinnest obtainable glass, which must not be pressed directly upon the particles, but be kept separate from the slide by an annular ring of fine gold-beater's skin; this is very convenient. If the particles are moist from having been filtered out of water, I wash them off the slag-wool with perfectly pure distilled water, using only a few drops at a time, and instead of placing gold-beaters skin under the covering glass I use gold leaf which is rather troublesome to adjust, but admirable in its thinness, as it allows a 50th power to work well through the covering glass on to the slide, in fact, quite as well as with an uncovered slide.

All the movements of living corpuscles can then be observed, and the germination of bacteria can be seen from germs which were previously beyond our highest power to identify or even to detect the presence of except by the employment of a ray of electric light. A warm stage and moist slide are required to witness these highly interesting movements and processes of germination, but if the ray of electric light does not show floating particles no growths from minute germs ever make their appearance if the manipulations have been conducted with sufficient care.

Holding a strong opinion against the probability of finding specific disease germs in any form by which our present powers of observation can recognise them, I have endeavoured to collect evidence of the floating particles which are peculiar to the air and water admitted to create that lowered condition of health which is so much better recognised than its immediate causes are understood.

Four years ago I was instructed by the Committee of Lloyds to examine and report upon the condition of the atmosphere of the underwriter's rooms, about which there had been almost universal complaint. An easterly wind blowing up the Thames for some time at certain states of the tide caused a most unpleasant effluvium at the sewer gratings, and as the intake of air for the ventilation of these rooms was not very remote from the sewer openings, it was not remarkable that when the stench was very strong the underwriter's rooms were hardly bearable. I made a chemical analysis of the air taken from various parts of the rooms, and took a large number of specimens of the floating particles as well as I could with the glycerine covered slides in Dr. Cunningham's apparatus, an improvement upon Dr. Maddox's aëroscope.

The analysis showed a slight deficiency of oxygen and an excess of carbonic acid and ammonia, and the floating particles were so abundant as to accumulate in the vane in the tangible form of dust, besides depositing on the moistened collecting glass.

The dust formed a putrescible ferment and a deoxidiser, reducing nitrates to nitrites, and the particles showed under the microscope the usual bacteria, fungi sporules, oil globules, epithelium cells, and minute portions of animal and vegetable tissue; being, in fact, sewer air diluted with street air, and rendered worse by the exhalation of the large number of persons transacting business all day long.

The obvious remedy was to remove the intake of air from the vicinity of the sewer openings to the upper portion of the Royal Exchange, and the employment of other means of purifying the air which have been so far successful, that the well known underwriter's headache is now only epidemic at periods when the great storms are at sea, and not up the river, and it is surmised to be caused more by the news of wrecks than by the present by no means perfect atmosphere of the rooms. But the points of interest in the outcome of these experiments have since been carried further by a more minute and patient examination of the floating particles which are carried into the air of rooms in which no very unpleasant odour is usually perceptible beyond that perhaps which gives rise to the feeling called "stuffiness." The expression "badly ventilated," "muggy," "close," and "oppressive" as applied to the air of a room, particularly when these feelings are experienced after a meal to a greater extent than would be the case in other rooms, may generally be taken to indicate an inlet of impure air. This intake may be hidden in the most recondite manner; it may enter beneath an asphalted basement and ascend by a bell wire tube into the upper rooms, as I have more than once found it in the private rooms of some of the grandest hotels in London and Brighton, where no expenses had been spared in the construction. The inlet of impure matters may be conveyed behind skirting boards, through window and shutter casings, in the hollows of cornices and pilasters, and even by down draughts in what ought to be up-cast air shafts. But when I find the floating particles to be composed of living organic matter, and that matter contains cells or corpuscles of animal origin, possibly competent to reproduce pus or other degenerate cell growths, including, perhaps, contagium or tubercule, I consider the air of that room viatiated from some impure source, whether the inlet can be discovered or not.

The floating particles of living organised animal matter rapidly collected, and examined by the higest powers, so as to show that it is in energetic vitality, reproductive or fermentative, form an index to contaminations which so frequently accompany such morbid particles, as to lead me to conclude that these highly objectionable and dangerous *minutiæ* are sustained and perhaps stimulated by certain currents of air in which they float. The chemical composition of the air in which these matters are found in the greater abundance, distinctly proves its unwholesomeness, and while these currents of air may not be, and seldom are, fair samples of the average atmosphere of the rooms into which they enter, it is because of their distinctive characteristics that they can be sometimes detected by persons gifted with a very acute sense of smell.

I have frequently taken samples of the incoming stream of vitiated air which had scarcely any peculiar odour. In these I have found the oxygen reduced, and the carbonic acid and ammonia very considerably increased. Bearing floating matters which may be quite free from specific disease germs, and diluted with the purer air from the windows and doors, such contaminations are precisely those which I generally find in some part or other of the rooms and places of public resort, which cause headache, nausea, and impaired vigour of mind and body. Without infecting the inhabitants with specific diseases, air of this kind produces precisely that lowered condition of vitality, which we are told on the best authority, conduces most largely to the absorption of every description of infection.

Similar floating particles are frequently found in water cisterns even where scarcely any can be found in the air of the living rooms, but I cannot at present connect their presence as indicating injury to health so clearly as I do the floating particles generally carried in impure air. If, however, the analysis of the water in the cistern proves it to be inferior to that in the mains, and the quantity of living particles is very obvious, I should condemn the water, and search out the inlet of impure air which carries the floating matter and so contaminates the water. In several instances I have lately found entire families suffer from impaired health, only attributable, as far as was known, to water impregnated with objectionable matter from the air. But as the pollutions proceed from the floating particles in the air, the injury to health may have been due to the impure air finding its way at certain times into the sleeping appartments. This I have known to occur at night, although it could not be detected at any time in the day.

Without laying too heavy a stress on the influence of the minute particle *per se* on health, I am impressed with the indications some of them afford of the introduction of the impure air which supports them, but this is only reliably the case when the matters found are animal organisms, floating about in vigourous vitality.

The PRESIDENT rose to move a vote of thanks to Mr. Bartlett for the paper he had contributed, and which he said was of general interest. In order that the business of the Section might be speedily concluded, however, it was not desirable that they should discuss this subject.

The vote of thanks was seconded and carried.

On "The Improvement of Climate with Slight Elevation," by THE HON. F. A. ROLLO RUSSELL.

RECENT observations have completely disproved the rule which only thirty or forty years ago was believed to represent the facts, that temperature decreases regularly with increasing altitude.

From Mr. Glaisher's observations at Greenwich from June 25th to August 6th, 1868, it appeared that from 9 a.m. to 3 p.m. the temperature at 50ft. was from 1°·9 to 3°·9 lower than at 4ft., but from 6 p.m. to midnight from 0°·4 to 3°·4 higher. At 10 p.m. and midnight temperature was 3°·4 and 3°·3 higher at the upper point. Humidity was found to be from 4° to 6° greater at 50ft. than at 4ft. between 9 a.m. and 3 p.m., but after 6 p.m. it was less, and at midnight 6° less.

From May to December, 1873; from January to July, and during December, 1874; and during January, February, and March, 1875, observations were taken at Kew Observatory, 10ft. above the ground, and at the Pagoda, 4400ft. distant E. by N., at the heights of 22ft. 6in., 69ft., and 128ft. 10in., all at the hours of 9 a.m., 3 p.m., and 9 p.m. In examining some of the results obtained, which were published in a Blue Book, we shall call the Observatory Station O, the lowest Pagoda Station P, the middle P′, and the highest P″. For the period of 19 months

The mean maximum reading	at O	was 56·2.
,, ,, ,,	at P	,, 55·7
,, ,, ,,	at P′	,, 55·28
,, ,, ,,	at P″	,, 54·57
The mean minimum reading	at O	was 42·2
,, ,, ,,	at P	,, 42·3
,, ,, ,,	at P′	,, 42·67
,, ,, ,,	at P″	,, 42·83

In January, 1874 and 1875, the mean diurnal range

At O was	10·7 and 7·7
At P ,, ...	11·2 and 7·6
At P′ ,, ...	10·6 and 7·3
At P″ ,, ...	9·6 and 7·2

In July, 1873 and 1874, the mean diurnal range

At O was	18·4 and 21·4
At P ,, ...	16·7 and 19·7
At P′ ,, ...	14·5 and 18·3
At P″ ,, ...	14·2 and 16·8

In May, 1873 and 1874, the mean diurnal range

At O was	....	16·0 and 17·1
At P „	....	14·5 and 16·3
At P′ „	....	13·9 and 15·0
At P″ „	....	12·9 and 13·6

The total mean monthly diurnal range for the nineteen months was as follows :—

At O	....	14·03
At P	....	13·34
At P′	....	12·54
At P″	....	11·68

The monthly means of maxima and minima were as follows:—

At O	....	56·2 and 42·2
At P′	....	55·78 and 42·57
At P″	....	55·07 and 42·75

The monthly mean maxima in July, 1873, and minima in January, 1874, were:—

At O	....	73·2 and 36·5
At P′	....	71·7 and 37·2
At P″	....	71·1 and 37·6

In winter, with a clear sky, the temperature at P″ was on an average 0°·54 higher at 9 am. and 0°·86 higher at 9 p.m than at 22ft. 6in., the station P. And in foggy weather 1°·13 and 2°·80 higher respectively. The following extreme differences were observed in foggy weather in September and October, 1873, at 9 p.m.:—

In September	at P′,	4·4	above P.
„ „	at P″,	6·1	above P.
In October	at P′,	6	above P.
„ „	at P″,	10·8	above P.

There is no instance of temperature at this hour being more than 1° lower at P″ than at O.

At 9 p.m., during anti-cyclones, temperature is between 1°·5 and 2° higher at P″ than at P, and humidity between 3 and 6 per cent. lower.

During fogs in summer, the means at P for temperature were 51°·1 and at P″ 55°·25, and for humidities 90·3 and 78·5 respectively. In winter fogs, temperature at P was 32°·61 and at P″ 35°·41, and humidity 94 and 89·1 respectively.

The mean humidity at P, surrounded by trees, for the whole time was 78·1, at P′ 76·8, and at P″ 76·8.

At 9 a.m. and 3 p.m., the mean humidities differed little. At 9 p.m. they were, at O, 81·4; at P, 82·7; at P′ 80·4; and at P″ 80·1.

The following table shows the average humidities at 9 a.m., 3 p.m., and 9 p.m.:—

		O	P′	P″
9 a.m.	Summer	72·8	72·5	72·7
	Winter	89·0	87·2	86·9
3 p.m.	Summer	60·7	61·2	61·5
	Winter	79·8	78·6	78·8
9 p.m.	Summer	77·9	75·5	75·1
	Winter	87·0	84·8	84·6

Observations have now for some months been carried on by the Meteorological Society at the top of Boston Tower, 270ft. high; on the belfry, 170ft. high; and at 4ft. above the ground below; and, so far, the results are similar to those for Kew, though, of course, at these great heights, temperature is, on the whole, lower than near the ground.

At the Radcliffe Observatory, Oxford, observations have been taken for many years of the maximum and minimum; and 10 a.m. temperatures at 105ft. and 5ft. above the ground.

The excess or defect of mean monthly temperature, calculated from the means of maxima and minima, at 105ft., compared with 5ft., for the 10 years, 1863-72, is as follows:—

Jan.,	+0·2	Apr.,	+0·1	July,	0·0	Oct.,	+0·5
Feb.,	+0·1	May,	−0·1	Aug.,	+0·5	Nov.,	+0·3
Mar.,	0·0	June,	−0·3	Sept.,	+0·7	Dec.,	+0·3

This gives an excess for the year in favour of the upper station of about 0°·2. At this observatory the difference between the minima in the hard winters of 1879 and 1880 was very slight. It may be well to remark, however, that the upper thermometer is here much exposed to the sky, rain, and wind, and that evaporation of moisture from its surface would be more rapid than on the lower one.

At Camden Town, Mr. Symons found in the years 1867-71, from observations on two thermometers, one 4ft. and the other 20ft. above the ground, that at 9 a.m. there was, on the whole, a slightly higher temperature, about 0°·3 at the upper point, and that the mean monthly range was from 0°·50 to 0°·75 less.

Prof. Ragona Scina found the temperature at 98ft. above the ground always colder than at 121ft. at midnight, the means for the months October to April ranging from 0°·91 less in October to 0°·38 less in March.

With regard to differences of temperature between hill and valley, we find results similar to those for artificial elevations, at least when the upper station is situated on the edge of a not very extensive eminence.

Mr. Dines, in 1871, made observations at two stations, Cobham and Denbies, Cobham being situated close to the river Mole, 65ft. above the sea, and Denbies at an elevation of 610ft., the two places being separated by a gradual slope of 6¼ miles.

The following table gives the

	Means of maxima.			Means of minima.	
	Denbies.	Cobham.		Denbies.	Cobham.
January ...	35·2	37·7	...	28·5	27·3
February ...	45·8	48·8	...	36·7	36·3
March ...	53·2	55·9	...	36·4	35·3
April ...	55·0	58·9	...	40·9	40·7
May ...	61·9	66·4	...	41·7	40·0
June ...	63·9	68·4	...	45·9	46·4
July ...	69·4	73·2	...	51·9	53·1
August ...	75·5	77·7	...	53·7	51·5
September ...	65·7	69·6	...	48·8	47·1
October ...	56·9	59·8	...	42·2	40·4
November ...	42·7	45·6	...	31·9	30·0
December ...	40·6	43·2	...	33·0	31·7

The mean of all the maxima for 18 months was about 3°·2 less on the hill than in the valley, of all the minima, about 1° higher.

The hottest day produced 91°·4 at Cobham, and 84°.2 at Denbies.

The coldest night produced a minimum of 1°·2 at Cobham, and of 14° at Denbies.

The minima were six times below 10° at Cobham, with an average of 6°, while at Denbies the average minima on the same nights was 15°.

The mean daily range at Cobham was 19°·0, at Denbies, 14°·8.

Mr. Dines has also made observations in 1876, 1877, and 1878, on the temperature at 4ft., and at 50ft. 9in. above the ground. From these he found the average of mean maxima to be 1°·23 lower at the upper station, the mean minima 0°·89 higher, and the mean daily range 2°·11 smaller. The mean daily range was 15°·47 at 4ft., and 13°·36 at 50ft. On many evenings about sunset temperature was much higher at the upper level. For instance, on the 31st of October, 1880, at 7 p.m. on the tower it was 68°, at 4ft. above the ground 58°·5;

and on March 16, 1882, 54°·1 on the tower, 44° at 4ft., and 30°, by an exposed thermometer, at 6in. above the grass. These great differences seem to occur only when the sky is clear or covered with cirrus. Mr. Dines confirms the view of Mr. Glaisher that in the middle of summer equality of temperature occurs between 5 and 6 a.m., and p.m., and we may, perhaps, place it with tolerable accuracy at about one hour and three quarters after sunrise and before sunset, throughout the year.

On June 16th, 1882, I obtained the temperature at 2ft. above the ground betwen 4.30 and 4.50 a.m.; on the top, and at the bottom of Richmond Hill over the grass of the Park. The night had been fine, and the sky was still clear at 4.30. There was no mist on the ground, but the sun was shining dimly. The temperature at the top was 40°·5, and on the level below, about 300 yards distant, 38°·5.

Six found a difference on some clear nights of 10 deg. in the temperature at 220ft. from that at 7ft., the upper station being always warmer at night.

Observations taken in Switzerland a few years ago shewed that a much milder and more equable climate prevailed at a few hundred feet above the valleys than at the bottom, where the vegetation of the hillsides would not thrive.

In an ascent of Snowdon on April 15, 1875, with various meteorological instruments, I took the temperature about every 300 feet in ascending, and every 500 feet in descending, and from the results concluded that on that day, at 9.15 a.m., temperature at 860ft. was slightly higher than in the valley, and at 7.10 p.m., at 730ft., about the same as at Llanberis. The weather was fine and hazy.

The frost of December, 1879, was remarkable for its great severity and long duration, and Mr. Marriott has collected valuable statistics regarding its distribution in the British Isles. From these it appears that at Farley, 638ft. above sea-level, the absolute minimum recorded during the frost was 17°·0, while at Oakamoor, 350ft. above sea-level, and only a mile distant, the great cold of 1°·1 was reached. Similarly at Cheadle 646ft. high, the minimum was 17°.6, while at Tean, 470ft. high, the minimum was 2°.0. These stations are situated respectively on the hill and in the valley.

Let us now compare the results, chiefly those obtained at Kew Observatory; with the results of observations at six climatological stations in the year 1880, three of which are situated inland and three on the sea-coast.

The following table exhibits the altitude of each station, the daily means of minima and maxima, and the mean daily range.

The stations are chosen at random, and from comparisons with others, I believe they are fairly representative :—

	Height above sea.	Mean Min.	Mean Max.	Mean Range.
Isleworth	68	42·0	57·4	15·4
Aspley Guise	433	41·4	55·7	14·3
Chester...............	65	41·9	56·4	14·5
Teignmouth	50	45·3	57·8	12·5
Worthing............	28	44·4	56·0	11·6
Colwyn Bay	180	43·2	55·5	12·3

The mean of the mean daily range of the three inland stations was 14°.73, and of the three coast stations 12°·13.

The mean daily range of the environs of London is given by Dr. Clarke at 15°.

We have seen that the mean daily range at Kew Observatory for the 19 months Pagoda observations was 14°·03. In these 19 months, however, autumn is not fully represented. By adding to the Kew Observatory range the quantity 1°·37, which makes it equal to Isleworth, and to the ranges for the Pagoda their due proportions, we shall get values comparable with those of the other stations, and the following table gives the results :—

	Mean Daily Range.	
Isleworth	15·40	
Greenwich	15·2	for 1880.
Kew Observatory............	15·40	
Chester........................	14·50	
Aspley Guise	14·30	
Pagoda, Kew (P)	14·63	
,, ,, (P′)	13·76	
,, ,, (P″)	12·82	
Teignmouth	12·50	
Colwyn Bay..................	12·30	
Worthing	11·60	
Cobham 4ft...................	15·47	
,, 50ft.	13·36	

Here it appears that the daily range of all the inland stations exceeds that of the two higher Pagoda stations, and that the daily range of P″ exceeds by only 0°·32 the daily range of Teignmouth, and by 0°·52 that of Colwyn Bay. Aspley Guise, which stands high, and has the smallest daily range of the inland stations, yet exceeds P″ in daily range by 1°·48.

At two seaside climatological stations there are two points of observation, at unequal altitudes, and from these we gather that, at the seaside, daily range increases fast with altitude and distance from the sea—exactly the converse of the rule at inland places with regard to hills and valleys. Indeed, at a short distance from the sea, on high ground, the moderating influence of the ocean reservoir seems to be lost. But a depression or valley terminating at the sea-shore would shew a much lower evening temperature, even close to the sea-shore, than the top of an adjoining cliff. It seems that the small daily range of the sea-shore must be due, first, to the balancing radiation from or to the equable ocean mass; secondly, to more copious moisture preventing radiation to space; and, thirdly, to sea-breezes. Thus, the warmest situation would be one close to the sea, a little raised above it, say 25ft., with a very full view of the sea, and not too wide an exposure to the sky.

We have seen that the greatest differences between the temperature near the ground and at some height above it have been observed during ground fogs. Radiation then seems to proceed from the fog stratum through the drier air above it almost as from a grassy surface. After the hard frosts of the end of January, 1880, a very light warm current from the south supervened on the 30th and 31st, greatly raising the temperature. The ground having been much chilled, did not thaw in the shade, even when the thermometer rose on these days to 45° and 50°, and an exceedingly dense ground fog was found. At Greenwich the highest temperature on the 30th was 50°·7, but at midday a thermometer sunk 1 inch below the surface of the earth registered only 34°. On the 31st temperatures of air and ground were respectively 48°·6 and 33°·2, and on the 1st of February 45°·7 and 32°·8. These enormous differences, though probably not so great as would have been registered between the soil and the air 30ft. or 40ft. above it, are sufficient to account for the dense ground fog produced. The air must have been cooled far below its dew point. The following table exhibits the maximum temperature in air of several days in January and February, the mean temperature of those days, and the temperature at a depth of 1in. below the surface of the earth at midday.

	Max.	Mean.	1in. below surface.
Jan. 30	50·7	38·8	34·0
,, 31	48·6	38·5	33·2
Feb. 1	45·7	34·6	32·8
,, 2	47·2	35·2	37·5
,, 3	45·5	40·7	35·2
,, 4	42·1	36·5	33·2
,, 5	45·6	35·2	33·2

The various observations above noticed clearly establish the following conclusions:

1. That the mean temperature, at a height of 100ft. above the ground, does not appreciably differ from the mean temperature at 5ft., but seems slightly to exceed it.

2. That the means of daily maxima, at heights of 69ft. and 128ft. 10in., fall short of the mean maxima at 10ft., and still more of the mean maxima at 4ft.

3. That the means of daily minima, at heights of 69ft. and 128ft. 10in., exceed the mean minima at 10ft., and still more the mean minima at 4ft.

4. That there is a certain altitude, apparently about 150ft. above the ground, at which, while the mean temperature is equal to that at 4ft., the maxima are lower and the minima higher than at any lower point.

5. That, on an average of 19 months, the mean of maxima was about 1°·5 lower at 128ft. 10in. than at 10ft., and the mean of minima about 0°·55 higher.

6. That, in cyclones, the higher, and, in anti-cyclones, the lower points, generally have the lowest mean daily temperature.

7. That the mean night temperatures are always highest at the higher points, and the mean day temperatures always lowest.

8. That at sunset in clear or foggy weather temperature falls much faster near the ground than at some height above it.

9. Equality of upper or lower temperature seems to occur about two hours before sunset and after sunrise, but varies with the season.

10. That in clear weather and low fogs, between sunset and sunrise, temperature is always, or nearly always, higher at heights varying from 50ft. to 300ft. above the ground, than at heights varying from 2ft. to 10ft., and 22ft.

11. That in bad weather the higher points are coldest, both by night and day.

12. That in foggy weather, especially in ground fogs, temperature is very much lower near the ground than at heights of 50 to 300ft.

13. When a thaw takes place after a hard frost, temperature is much higher at some elevation above the ground than near it.

14. A thermometer at 50ft. has shewn a temperature 10° above that at 4ft., and 24° above that of the grass at 7 p.m.

15. The mean daily range decreases rapidly with height, and at 128ft. is about 2°·5 less than at 4ft.

16. The mean daily range at a height of 128ft. nearly approaches that of the English sea coast, and the mean daily range at 69ft. is about midway between the range of inland and of sea-side stations.

17. The mean humidity at 69ft. and 128ft. is more than one degree less than at 22ft. surrounded by trees.

18. In the middle of the day humidity is slightly greater at 69ft. and 128ft. than at 10ft., but at night between two and three degrees less.

19. The humidity at heights from 50ft. to 300ft. is at night much less than near the ground, and the mean humidity is less than at most seaside stations.

20. Places situated on hills or slopes from 150ft. to 700ft. above a plain or valley have a much smaller annual range, and also a smaller daily range than places on the lower level.

21. A higher station (545ft.) may, on the coldest nights, register minima 12 or 13 degrees higher than the lower, and on the hottest days maxima 7 degrees lower.

22. It appears that at seaside stations minimum temperatures decrease and daily range increases with elevation from the shore.

Summing up these results we find that a height about equal to that of the upper rooms in a high house a more equable and drier climate prevails, than at lower levels, drier than at the sea side, and with a daily range not much greater, much less cold on the coldest and on foggy nights than down below. Conditions on natural elevations are on the whole similar.

With regard to their bearing upon health, we may conclude that, in ordinary circumstances, delicate persons should not sleep on a ground floor, or live in low, confined situations, and that living near the top of a high house or on the ridge of a hill, might be of great benefit in many cases of lung and throat diseases, and in cases where night air has a bad effect. That the ground floor of all houses should be built above the ground level and well ventilated underneath, and that no houses penetrable by damp, especially cottages in the country, should be considered habitable in which these precautions have not been taken. Of course, basements warmed constantly by fires and surrounded by drained and paved soil are less objectionable.

That in a thaw after hard frost, when colds and chills are frequent, fires are more necessary in lower rooms than during frost. That in frosty weather there must be some economy in admitting fresh air to a house from the upper part, where the air enters less cold than near the ground. That chills are more probable in low situations and from draughts in lower rooms about the time of sunset than at higher levels. That close proximity to rivers, where extremes of temperature and damp mists occur, is most unwholesome for rheumatic and delicate persons. That for soldiers in time of war, and all who camp in the open air, it must be of great advantage to be raised a little above the ground at night. Some of these conclusions only confirm principles which have long been known and acted upon.

A unanimous vote of thanks was passed to the author.

"*On the Influence of the Purity or Impurity of the External Air on the Health and Moral Tendencies of a Dense Population,*" *by* RALPH CARR ELLISON.

It appears to me, as an old inhabitant of the district contiguous to Newcastle, and one who has known the banks of the Tyne intimately from 1820 downwards, that in studying the sanitary position of this city and its neighbourhood, one of the first considerations must be whether the atmospheric conditions are upon an equality with those of some other great manufacturing centres, such as Manchester. Again, whether the host of tall chimneys and steam-vessels and tugs which line the shores of the Tyne or traverse its waters, emit respectively more or less of opaque smoke than similar tall chimneys and steamers lining or navigating the Thames between Westminster Bridge and the sea.

If we find that the air, as at Manchester or along the Thames, is continually occupied by a certain haze of smoke, to which each tall chimney is seen to be contributing a certain permissible stream, which, however, it never long exceeds with impunity—then we may say that the path of sanitary science at Newcastle and along the Tyne immediately above and below the bridges, for some five miles either way, does not present any very abnormal atmospheric problem, but only such as sanitary students are accustomed to meet in other great seats of manufacture or other ever-busy sea-ports.

But is this so? I fear not. In the vicinity of the Tyne uch is the cheapness of the coal, that it has been always used with a most lavish and wasteful profusion. Mechanical stoking in connection with furnaces adequate to the work to be done has rarely been adopted. Manual stoking seems to be the rule, and that by men working in the most old-fashioned and perverse method, according to which all fresh fuel, instead of being placed in front of the furnace, is thrown back under the very shaft of the chimney, so that its cloud of intensely thick and black smoke shall pass directly into the atmosphere without ever having passed over the furnace, which might under better management have converted most of it into flame, thereby greatly economising fuel. So obstinate are the unskilled men employed as stokers, that they rarely thrust back the red hot cinders in front of the fire, in order to make room for a fresh supply to be laid in that position, so that its smoke might pass over the whole body of fire behind and be commuted into flame. They say, either that they are not supplied with the proper implement for thrusting back the fuel, or they decline to use it.

Again, the cheapness of coal fuel is a continual temptation to defer the construction of new and better furnaces. The old ones may be made to do the work by forcing them with a lavish supply of coal, which unskilled stokers are allowed to apply in any way they may be pleased to prefer.

Such are the unhappy tendencies which prevail on the estuary of the Tyne. To neutralize them and render our tall chimneys as little corruptive as may be to atmospheric purity as those upon the banks of the Thames or the Irwell would require the anxious deliberations and the unceasing vigilance of our corporate bodies in Newcastle, Gateshead, and elsewhere, and hearty co-operation on the part also of county magistrates.

I am unable to say that really adequate efforts have yet been directed to this beneficent work.

The discharge of densely opaque black smoke from the chimneys of furnaces, factories, breweries, and the like, in vast volumes, after every replenishment of fuel, and this for long periods, is the rule and not the exception. There is, however, one honourable and distinguished exception, that of Sir William Armstrong & Co., at Elswick, where a vast business is conducted with as little production of smoke as possible, and with corresponding economy of fuel. I know not whether any other such exception can be quoted. The smoke pall which hangs over Newcastle week after week, from Monday morning till noon on Saturday, is fearful to behold. Gateshead responds with slightly abated proportional contribution to the darksome cloud. Whether the general display will reach its normal intensity during the week of the Sanitary Congress will be an interesting matter to observe.

We are clamorously assured, however, that mere coal-smoke, unlike that from lead works, is not injurious to human health. So say the manufacturers, and so repeat all who are anxious for their good-will. But what say the medical profession when these gentlemen and their families call in their advice for chronic dyspepsia, for maladies of the respiratory organs, and for general debility? What say they to these applicants and to a host of patients from the families of tradesmen who are well-to-do and able to expend money in search of restored health. They are told that the first condition of improvement must be sought in removal from the air of Newcastle. They are apprized that the air of this town and neighbourhood is sadly deficient of ozone, that vivifying and invigorating principle which renders country air so healthful and so delightful. Sometimes they seek the moorland resorts of Northumberland at Rothbury or Wooler; on the sea coast at Seaton Carew and Redcar are favourite resorts to the southward, together with Saltburn. Between the Tyne and the Tweed are Cullercoats, Whitley, Newbiggin, Alnmouth, Bamborough, and Spital, all depending for their prosperity greatly to visitants from Newcastle coming under medical advice. In like manner the popular spas of Croft and Gilsland.

But the working men and their families cannot come; they can enjoy no such means of recruiting impaired health.

Compare the pallid faces of the men, women, and—alas!—above all, of the children born and brought up in this great town. Compare their pallid countenances with the ruddy aspects of the good folk of the North Riding of Yorkshire, or of the City of York even. Compare them with the still ruddier North Northumbrians. And then go and believe the cruel myth that coal smoke does no harm to human health.

To compensate for the want of exhilarating ozone in the air, an inordinate appetite for the stimulating food of butcher meat besets our town and colliery populations, and, concomitant with this, a raging thirst for beer, ale, and ardent spirits. The air has lost its virtue; it is charged with sulphureous fumes and with bitter black carbonic dirt, which must be absorbed into the lungs; and these are two ingredients which we are told are not unwholesome to man.

Alas for the young children! Are we to believe that these little pale-faced creatures could ever keep up the present number of the population? Assuredly not. The town population requires to be incessantly recruited from the country, or it would gradually die out. And yet, forsooth, coal smoke is not unwholesome, in whatever excess!

Now let us see how the smoke affects the ventilation of dwelling houses—even of the best class of dwelling houses in Newcastle and Gateshead.

Go into the streets of these towns on the finest day in summer, and there will hardly be seen a window open. The good lady of each house and her domestics are afraid of "the blacks" which would enter. Let any one think what this perennial non-ventilation of eating-rooms and of bed-rooms must imply—the impurity which it of necessity involves. And yet coal smoke is not unwholesome; it needs no regulation; let manufacturers make as much of it as they and their stokers are pleased to think convenient!

As regards intemperance, it is too true that the people of rural villages in the purest localities as to air are inclined to excess in drink on market days, or on Saturday evenings, when they get together. But it is not true that they are equally intemperate with our urban population—even when equally well furnished with money. And, above all, they take their cue from the unhappy example of the urban people, as it reaches their knowledge. Were our great towns more temperate, our villages would soon respond with marked improvement, now that education is everywhere diffused.

One of the worst effects of unregulated excess in the discharge of smoke from a host of tall chimneys is the perpetual state of unsightly dirtiness which it compels the people of the working class to live in. They can scarcely remain personally clean, or enjoy the honest pride of a clean shirt, except for a very few hours. The consequence is an inevitable loss of self-respect, which is much to be deplored. A considerable number of the upper class in the town and neighbourhood are painfully aware of the evils I have attempted to describe, most briefly and imperfectly; above all, the clergy and the ministers of religion generally are painfully alive to them, as standing seriously in the way of the impovement and elevation of their people.

Medical men are universally ardent advocates of smoke regulation and abatement.

The architects are all heartily on our side, for their noble art is degraded in all its productions by the visible pollution with which it is soon coated.

The owners of mansions and landed property, and the inhabitants of villas in the vales of Tyneside, Derwent, and Ravensworth are all heavily visited by the smoke-bane of Newcastle and Gateshead, which closes over them like a pall, whenever an easterly or north-easterly wind may bring night over them at mid-day.

In the case of London, it is the smoke that proceeds from a countless multitude of domestic chimneys, which is the most difficult to regulate and diminish. Not so in Newcastle, where there is no such stupendous extent of territory covered by dwelling-houses.

Accordingly we find that on Sundays, when none but domestic chimneys are in operation, the smoke over the town ceases to be serious or worthy of much attention, even in winter time, though, doubtless, better arrangements would much reduce it.

If I be asked, what is the path of improvement which may be hoped for in Newcastle for the diminution of its present utterly disgraceful cloud of smoke? I reply, that the time has evidenly come when all those who feel and deplore the presence of so great an evil may associate and organise themselves into an active and efficient body of reformers, when representations, petitions, and deputations cannot be long without effect on the Corporations of Newcastle and Gateshead. Nor is it necessary to stop there. They can have recourse to the Local Government Board in London for information and advice as to the best method of urging this important subject, not only on the Municipal Bodies, but upon the Urban and Rural Sanitary Districts in the two adjoining counties which border the navigable portion of the Tyne. There is endless work to be done, and each step will produce some perceptible amelioration. Let us then begin.

The President moved a vote of thanks to the reader of the paper, which, he said, had quite proved that people could get rid of smoke if proper steps were taken. It was clear that the law was sufficient for the purpose if it were only put in force, which it had not been up to the present. The attention of the authorities could not be be too often directed to this matter, which was one of public interest.

Mr. C. S. Smith said he thought the paper was a very useful one, and the reader of it had certainly called attention in it to a subject which was worthy of a very great deal of attention. The smoke was, no doubt, a very great nuisance, but they had to take into consideration the fact that the prosperity of this district very greatly relied upon manufactures, in which the use of coal in large quantities was absolutely necessary. The authorities had always found some difficulty in putting the restrictions in regard to smoke very firmly into force, as they feared that they might interfere with the prosperity and trade of the district. Alkali manufactories were an abominable nuisance, as they emitted a deleterious smoke which did harm to vegetation, and, he presumed, to human life. The most stringent measures should be used in regard to alkali works; but he pointed out that the power in regard to them was exercised by Government officials. He said that such meetings as the Sanitary Institute were holding in Newcastle were calculated to cause Parliament to give greater consideration to further powers sought by municipal bodies.

Captain Douglas Galton, C.B., said he should like to impress upon the inhabitants of Newcastle that much had been shown by two exhibitions in the course of last winter, one at Manchester and the other in London, that it was perfectly within the power of the owners of manufactories to prevent the emission of black smoke. It was quite certain that all black smoke from bituminous coal could be prevented, and he hoped that within a short time they would have that fact recognised all over the country. At several works in South Staffordshire the formation of black smoke was avoided by the adoption of some of the various means shown at the Manchester and the London Exhibitions, and if the manufacturers in the Newcastle district would turn their attention to this subject, he was sure they would get rid of the smoke nuisance.

After a few remarks from Mr. E. C. Robins, the vote of thanks was agreed to.

"*On the Establishment of a Library for a Special Branch of Sanitary Information at Newcastle*," *by* R. B. Grantham, M.Inst.C.E., F.G.S.

Having for some years taken an interest in Sanitary matters professionally, and in occasionally writing upon subjects connected with the Science, and promoting its objects, at one period as Chairman of the Committee of the British Association, for seven meetings of that Society, I am on this occasion desirous of taking part in the proceedings of this Congress, and beg to suggest that a distinct and special collection of authentic publications on Sanitary Science should be formed here, if those who have the means and opportunity of aiding such a suggestion will agree to it, and will interest themselves in forming and maintaining such a collection. It would prove of great service to those who practice in that Science, and I should hope by quoting the words of Dr. Alfred Carpenter, in his excellent inagural address to the Sanitary Institute in the Session of 1880-81, it would promote my object, viz., that "the arrangements which the Council have made for the formation of a Local Branch of the Institute in the town which invited them, will be the means whereby a lasting impression may be made upon the district, and something be left behind which shall mark the visit, and make it remembered by the student in Sanitary Science whose enlightenment has commenced with the visit of the Institute to his place of residence."

I am also desirous of promoting and extending by all the means at command the teaching for which the Institute was established, and for which it is dependent upon the support of all who value the principles that it is its endeavour to establish.

The following is a list of some of the works and documents, which will be required to form a distinct Sanitary Science Section in a Library.

The principal Acts of Parliament affecting Sanitary legislation, viz. :—

Gas Works Clauses Act, 1847.
Water " " " "
Public Health Act, 1875.
" " " Water, 1878.
Rivers Pollution Act, 1876.

Local Government Board. Model Bye Laws for Sanitary Authorities.

Chambers, George F. Digest of the Law relating to Public Health and Local Government.

Glen, W.C., Q.C. Public Health Act.

Michael and Will. On Gas and Water.

Woolrych. On the Metropolis Local Management Acts, 2nd Edition.

Denton, J. Bailey, M.Inst.C.E. Sanitary Engineering.

Field, Rogers, M.Inst.C.E. Bye Laws and Regulations with reference to House Drainage.

Galton, Douglas, C.B., F.R.S. Observations on the Construction of Healthy Dwellings.

Latham, Baldwin, M.Inst.C.E. Sanitary Engineering.

Rawlinson, Robert, C.B. Suggestions as to Drainage, Sewerage, and Water Supply.

Report of the Committee of the Local Government Board on Treatment of Town Sewage.

Sixth Report of the Royal Commissioners on Pollution of Rivers.

Parkes, E. A., M.D., F.R.S. A Manual of Practical Hygiene.

The Principal Acts relating to the Duties of Inspectors and Surveyors under the Public Health Act, 1875 :

Public Health Act, 1875.
" " Water, 1878.
Canal Boats Act, 1877.
Sale of Food and Drugs Act, 1875.
Rivers Pollution Act, 1876.
Artizans and Labourers' Dwellings Act, 1868.
Alkali, &c., Works Regulation Act, 1881.

Corfield, W. H., M.A., M.D. The Laws of Health.
" " Dwelling Houses: their Sanitary Construction and Arrangements.

de Chaumont, F. S. B. F., M.D., F.R.S. Manuals of Health. The Habitation in relation to Health.

Grantham, Richard B., M.Inst.C.E., F.G.S. The Reports of the Committee of the British Association in the years 1870 to 1877, on the Treatment and Utilization of Sewage.

Corfield, W. H., M.A., M.D. The Digest of the same.

Grantham, Richard B., M.Inst.C.E., F.G.S. On Public Slaughterhouses.

Grantham, Richard B., M.Inst.C.E., F.G.S. On the Drainage of Slough, Buckinghamshire.

The Transactions of the Sanitary Institute of Great Britain. Vols. I. II. III.

The works mentioned in the foregoing list are in the library of the Sanitary Institute, and they denote the kind of works which I am endeavouring to recommend as suitable to the purpose of commencing a collection of Sanitary works.

I have collected and have had bound together the Reports of the Committee of the British Association for the Treatment and Utilization of Sewage, and beg to present the volume as a commencement of the formation of the collection.

In the Appendix of the Third Volume of the Transactions of the Sanitary Institute is a list of the ordinary meetings of the Institute for the Session of 1881 and 1882, when the following papers were read:—

The Law in relation to Sanitary Progress, by W. H. Michael, Q.C., F.C.S.

Suggestions for the Management of cases of Small-pox and other infectious diseases in the Metropolis and large towns, by B. W. Richardson, M.D., LL.D., F.R.S.

The Present State of the Sewage question, by Professor W. H. Corfield, M.A., M.D.

Inaugural Address, by Alfred Carpenter, M.D.

The Administration and Hygiene of British Hospitals, by H. C. Burdett, F.L.S., F.S.S.

The Range of Hereditary Tendencies in Health and Disease, by G. Gaskoine, M.R.C.S.

An Obstruction by the Law to Sewage Disposal, by H. C. Stephens, F.L.S., F.S.S.

I have been in communication with Mr. H. E. Armstrong, one of your Honorary Secretaries, and he informed me that the Literary and Philosophical Society of this town possesses in their rooms one of the best libraries in the Provinces, and that a part of their premises have become available for this collection.

I know that great exertions are being made to establish a Library at Nottingham.

It has been intimated to me that the Local Government Board in London would supply to a Library at Newcastle some works and official papers, but with the stipulation that they should be properly provided with a suitable place, and be preserved and maintained for the use of those who take an interest in Sanitary Science.

On behalf of the Sanitary Institute I beg to present to the Free Library of Newcastle the books accompanying this paper.

Mr. C. S. Smith proposed a vote of thanks to Mr. Grantham for his paper, and also for the presentation he had made as the nucleus for a library.

Mr. T. P. Barkas seconded the motion, and said that they had in the town two libraries, one of which was one of the finest in the United Kingdom. They were about to spend £5,000 on books for the reference library now. He thought it would be best that these volumes should be given to the public library.

Mr. E. C. Robins, F.S.A., pointed out that the Government would probably be much more liberal to public free libraries than they would to subscription libraries. The chance of getting blue books and reports would be very much stronger in the one case than in the other.

The vote of thanks was then carried, and Mr. Grantham replied.

THE FOOD AND ENERGY OF MAN.

A LECTURE

By Prof. F. S. B. F. de Chaumont, M.D., F.R.S.

CAPT. DOUGLAS GALTON, C.B., F.R.S., IN THE CHAIR.

Although eating cannot be said to be in any way a new fashion, it has nevertheless been reserved for modern times, and indeed we may say the present generation, to get a fairly clear idea of the way in which food is really utilised for the work of our bodily frame. We must not, however, plume ourselves too much upon our superior knowledge, for inklings of the truth, more or less dim, have been had through all ages, and we are now stepping into the inheritance of times gone by, using the long and painful experience of our predecessors as the stepping stone to our more accurate knowledge of the present time. In this, as in many other things, we are to some extent in the position of a dwarf on the shoulders of a giant: the dwarf may, indeed, see further than the giant, but he remains a dwarf, and the giant a giant.

There is an old saying that "an army marches on its belly," by which no invidious comparison to snakes, or otherwise, was meant, but merely that soldiers must be fed if they are expected to do useful work. During the great wars of the early part of this century it used to be a common joke among the French that you should never ask an Englishman if he has fought well, but if he has dined well, and then you could be secure of his fighting. Many a true word is spoken in jest. On the other hand, many have affected to despise food, like the hero of Tennyson's "Maud," who complains that he has even to care for "wretched meat and drink;" or, like the modern æsthetic school, who profess to dine off the contemplation of a poppy or a lily, or it may be, a sunflower. Food is said to be a gross thing; but, then, so are coals, working in which is not conducive to refinement or delicacy of appearance—but without coals, where should we be? either in this *omphale* of terrestrial carbon, or anywhere else! The same with food; it may not be æsthetic to be seen consuming a beef steak, or bacon and greens, or even porridge and milk, but without these or their like, neither coal whipper nor æsthete would come to much good. Poetry is a beautiful thing, but the poet himself must come off his winged steed, and humbly acknowledge that he and his charger owe both their poetry and any other manifestation of energy to the food they have professed to despise and hold as exceedingly vulgar and material.

I do not mean to say that the time will come, still less that it is near, when we shall be able to feed poets as our great graziers do cattle, and so cultivate a pastoral or didactic, a humorous or an "Ercles" vein, by particular kinds of feeding,—but the thing is not preposterous,—it is conceivable, and the time may come when its possibility may be considered to be within measurable distance. The results of the Darwinian views of development and natural selection have been to show that the progress of all animals, man included, is most largely influenced by the ease or otherwise with which abundant and appropriate food may be obtained. Every thing seems to indicate that the most rapid advances towards civilisation, that is, the quickest development of the higher faculties, has taken place in the warmer regions of the earth, where food was abundant on account of the genial influence of a tropical or subtropical sun. When crowding became excessive, and food proportionately less easy to obtain, migrations to colder regions took place, arising from stress of circumstances, for the purpose of seeking "fresh fields and pastures new." There seems no reason to believe that man orignated at more than one centre, and it seems more reasonable to think that Eskimos and Lapps were driven to the circumpolar regions, than that they voluntarily selected such a dreary life, amid circumstances so adverse and arduous. This view is also supported by ethnological considerations.

By looking now at the histories of the races of man, we may learn the lesson that, when things are made too easy, man is inclined to fall away and deteriorate. The ancient tropical civilisations have gone to decay, and the nations that boasted them have either disappeared from the face of the earth or bow their heads to the yoke of the stranger. On the other hand, if things are made too difficult, man's development is arrested, as in the circumpolar regions. But, when the difficulty is not greater than can be successfully overcome with a fair amount of expenditure of energy, a high development is possible, both physically and intellectually. Hence, the masters of the world come from the temperate regions, where the forces of nature may be successfully grappled with, but where they neither succumb too easily nor oppose man's efforts too severely. In countries where the soil only requires to be "tickled with a hoe to laugh with a harvest," man is only too prone to enjoy his "keff," as the Eastern calls it, and more or less to dream the happy hours away; and,

> "Propt on beds of amaranth and moly,
> * * * * * *
> To hear the dewy echos calling
> From cave to cave thro' the thick-twined vine."

But this, though pleasant, is unproductive; so, by and bye, comes the hungry and hardy man of the north, and takes away both his name and country. Most of the earlier invasions and conquests arose from the necessity of the inhabitants of the more inclement regions seeking for supplies from those more favoured lands. Even a large part of early geographical discovery during the Roman Empire was due to a search after pepper, one of the most cherished condiments to aid digestion, more or less jaded with pampering and excess. Before the art of agriculture was generally understood, the men of colder and more inclement regions had either to gain a precarious livelihood by the chase or to make periodical raids upon their more favoured neighbours, and levy toll upon their more ample supplies.

The question has been much discussed as to what the original food of man was, and some people have made it a subject of excited contention. Arguments on one side or the other have been drawn from the shape of his teeth and the form of his digestive apparatus, but the most reasonable conclusion is that he is naturally a frugivorous or fruit-eating animal, like his cousins the monkeys, whom he still so much resembles. This forms a further argument in favour of his being originated in warm regions where fruits of all kinds were plentiful. But when the inevitable migration came, of which we have already spoken, what was the unfortunate man to do? A meal of wheat (a tropical plant originally), millet or maize, plantains, melons, guavas and mangoes, cocoa-nuts or jack fruit, might be all very well, but when he became reduced to beech-mast and acorns, and such tough roots as could be gathered in colder and temperate regions, he must soon have found it necessary to modify his frugivorous tendencies. Whether this change took place before or after his development out of the simian stage, that is, whether he was an anthropoid simian, or a simian man, we are not in a position to say—some are inclined to think that it was an advance made in consequence of his increase of intelligence, others that the intellectual improvement followed on the change of food. Whichever may have been the truth, it is noticeable that similar changes are found to take place in the habits of animals, even in the present day. There are flesh eating and fruit eating bears, flesh eating and fruit eating bats; whilst the practice seems to alternate even with animals of the same genus, species or individual. Polar bears, which are flesh eating generally, are sometimes driven to eat grass, which must be but unsatisfactory food to them, but the fact is proved by their stomachs being found full of it. In an ingenious paper, read at the late meeting of the British Association at Southampton, Mr. W. P. Duncan discussed the conditions under which the quadrumana, or apes, were gradually pushed southward on our globe by the increasing cold, and he suggested that the geographical distribution of land and water must have prevented some of them from reaching the regions which are now tropical, and where apes flourish in the present day. As the cold increased and fruit supplies diminished, the apes must have died off, unless they were able to find some other source of food,—and the author suggested that this they probably found in the shell-fish on the sea shore, and perhaps occasionally in the flesh of some stranded whale or other cetacean. Carnivorous monkeys are not a usual thing, but it was very curious that this suggestion, advanced on theoretical grounds, was confirmed by the personal testimony of a gentleman present, who told the meeting that he had been himself witness to the fact that, on an island he visited, the monkeys came down to the shore and gathered shell-fish and eat them,—driven to do this in all probability from a deficiency of fruits in the island.

To some extent we may thus explain the origin of cannibalism, which has prevailed more or less in all parts of the world,—for even in our own islands bones have been found which bear evidence of having been those of human beings who had been devoured by their fellow men. Such at least is the opinion of competent archæologists. There are two causes which may lead to cannibalism, viz.:—Revenge and hunger. As regards the former it must be confessed that it would be a very complete vengeance, not only to conquer your enemy, but to eat him as well, surrounding him in short both in a military and a gastronomic sense. Perhaps this may be the origin of the expression, "to have *stomach* for a fight"! Among some tribes it was a point of honour to eat your enemy if you overcame him,—and this was very rigidly carried out among the North American Indians in former times. When they proposed to make war upon another tribe they were wont to use the expression, "Let us go and eat this nation." But they drew the line at enemies, and considered it quite wrong to eat their friends, even under stress of circumstances. Indians who had eaten enemies and sacrificial victims with not only a good conscience but lively satisfaction, were struck with horror at the acts of the Spaniards, who were driven by want to eat the dead bodies of their own countrymen.

Modern cannibalism has been most typically represented by the practice of the New Zealanders and other Polynesian islanders. Here again the habit probably arose from want of nourishing food, and particularly the absence of mammalian animals, or, indeed, large animals of any kind which might have furnished food for the hunter. Cannibalism in New Zealand is now a thing of the past, but not by any means a remote past, for there are probably men still living who have enjoyed a human steak. A brother officer of mine, who served there in the war of 1864, told me that an old chief had described to him with great gusto, mingled with a manly regret, the delights of a slice cut from the back,—the saddle in fact,—of a living captive, and eaten warm and quivering! I believe that South-Sea gourmands objected generally to Europeans, particularly Englishmen, as tasting too strongly of salt and tobacco. The general resemblance of the flesh of man to pork, however humiliating it may be, has long been noticed,—and the term, "long pig," has long been applied to it by the Fi-ji islanders. The occasional cannibalism which has arisen among shipwrecked crews and the like, need not be referred to more than to point out that man, when driven to extremity, will do pretty well anything to satisfy his appetite.

It is pretty clear that the resort to animal food, whether the result of the pressure of want from failure of vegetable products, or a mere taste and a desire for change and more appetising food, is one that took place many ages ago, probably in the earliest anthropoid if not in the latest pithecoid stage. No doubt some advantage was recognised in the more rapid digestion and the comparative ease with which the hunter or fisher could obtain food, instead of waiting for the ripening of fruits in countries which had more or less prolonged periods of cold and inclement weather. Some anatomical changes have doubtless resulted from the practice, but they are not of a sufficiently marked character to found much argument upon; all that we can say being that the digestive apparatus in man seems well adapted for digesting any food that is capable of yielding nutriment, and that even when an entire change is made in the mode of feeding the adaptability of the human system shows itself in a more or less rapid accommodation to the altered circumstances. There is one point, however, worthy of notice, and that is, whether man ought to be frugivorous or carnivorous; he begins life by taking food of animal origin, namely milk, upon which the young of all animals thrive best, whatever order they belong to. I do not think the most extreme vegetarian will propose to extend his practice to the sucking infant,—at least if he does he will prove himself an apt pupil of Mr. Malthus, and certainly check any undue increase of mankind.

But up to this time we have been talking of food and feeding without so much as proposing to define what we understand by food. Of course, a number of persons will at once say that that is clear enough,—we mean by food something to eat. That may be all very well, but there are many things we might eat that would do us little good, and many more that would do us a great deal of harm. Let us, therefore, try and define a food:—A food, then, is any substance which can be taken into the body and applied to use, either in building up or repairing the tissues and frame-work of the body itself, or in providing energy and producing animal heat, or any substance which, without performing those functions directly, controls, directs, or assists their performance. Within this wide definition it is evident that we include all the ordinary articles recognised commonly as food, and that we reject all substance recognised commonly as poisons. But it will also include such substances as *water* and *air*, both of which are essential for nutrition, but are not usually recognised as belonging to the list of food substances in the ordinary sense.

We may now inquire what are the substances that will come within our definition; what are the substances that can build up and repair our tissues; what are those that can provide us with animal heat and productive energy, and what are those that will regulate and control the work in our complex frames? Since the days of Prout, our first English organic chemist, it has been the practice to look upon *milk* as representing the food of man in its most perfect form—and subsequent investigation has gone to confirm this—with the reservation that the proportions of the constituents, although admirably adapted for the young infant, are not so well suited for the nutriment of adults. Now if we analyse milk we find that it consists of *five* kinds of substance, namely, casein, or cheese; fat, in the shape of butter; sugar, in the shape of sugar of milk; mineral matter, in the shape of a small portion of salts; and water. Now water forms about eighty-seven per cent. (or nearly nine-tenths of the whole), and the remaining thirteen per cent. is almost equally divided between the casein, butter, and milk sugar, the last slightly predominating in quantity. As we shall presently see, this relation is unsuitable for the food of adults.

When we examine the different constituents above mentioned, we find certain broad characteristics. In the first place, they are divided into organic substances, including casein, butter, and sugar, and inorganic substances, including the salts (or ash) and water. The main difference between them is that the former, the organic, are capable of change, of being split up, rearranged, and even reduced to inorganic substances, to be burned, in short, by uniting with the oxygen of the air, and thereby producing energy, as coal does in the fire of a steam-engine.

When we carry our investigation further, we find that the organic substances may be again divided into two distinct classes, namely, that which contains nitrogen (the casein), and those which do not (the butter and sugar). On ascertaining this, we are immediately struck with the remarkable fact that all the tissues and fluids of the body, muscles (or flesh), bone, blood,—all, in short, except the fat,—contain nitrogen, and, consequently, for their building up in the young, and for their repair and renewal in the adult, nitrogen is absolutely required. We therefore reasonably infer that the nitrogenous substance is necessary for this purpose. Experiment has borne this out, for men who have been compelled to live without nitrogenous food by dire necessity, and animals on whom the experiment has been tried, have all perished sooner or later in consequence. The non-nitrogenous food, the butter and sugar, was formerly thought to be employed in providing, by its combustion or union with oxygen, the animal heat necessary for the body. This was the doctrine taught by Prout and Liebig; and, in the main, it was not incorrect, but it was distinctly imperfect, an imperfection which it owed, however, to the imperfections of the collateral sciences of chemistry and physics on which it had to depend for guidance. This imperfection led to a curiously erroneous view of the relation between the production work of man and the food he requires. Less than 20 years ago, so late as 1865, it was taught by such experienced inquirers as Lyon Playfair and the the late G. H. Lewes, that the energy by means of which our productive work is done was derived from the disintegration of the nitrogenous tissues (the muscles, in fact) which are actively engaged in the work itself. It was supposed that it would be possible to measure the amount of work done by the excretion of nitrogen during its performance.

This theory was far from satisfying scientific inquirers, who saw grave reason to doubt it, and shortly after the time I have referred to, the observations of Fick and Wislicenus during an ascent of the Swiss mountains sounded the first note of objection. These were followed by the remarkable inquiries of Pettenkofer and Voit in Munich, and Edward Smith in England,

and by the careful experiments of my illustrious predecessor, Dr. Parkes, which quite established the facts of the other observers; indeed, they showed that, so long as work was carried on at a reasonable rate, not only was no nitrogen excreted above the normal amount, but that it was rather retained in the system, being utilised in increasing the size of the organs thrown into action. Therefore, that particular view of the origin of energy had to be abandoned, but in the course of the inquiry other pieces of valuable information were obtained. For instance, it was found that one of the functions of nitrogenous food was to control and regulate the use of oxygen for burning up the non-nitrogenous food, and that if an insufficient amount of the nitrogenous food were given the burning or oxidation was diminished, and if too great an addition of fat aud sugar or starch took place without increasing the nitrogenous food, the same result was obtained. This also threw a new light on the question of corpulence, which is with many people a truly vital one. Many of you may remember the history of Mr. Banting, the well-known undertaker of St. James-street, London, who had the misfortune to weigh 300lbs., or more than 21 stone, and who could only go downstairs backwards. He took the advice of his doctor, Mr. Harvey, and confined himself to a diet which consisted chiefly of nitrogenous food, such as meat, game, &c., little or no starch or sugar, except in the form of biscuit or toast, a very small amount of fat, and any wine or spirit that contained no sugar. The result was that he reduced himself to moderate dimensions, and he afterwards wrote a pamphlet in which he quaintly described his obesity as a *parasite*. This pamphlet created quite a flutter among corpulent persons, and the author's name was quickly turned into a present participle, and the verb "to bant," added to our receptive language. In many cases the results of "banting" were successful, in others they lead to serious consequences, and in some cases people imagined they were fully carrying out the system recommended if they *added* all that Mr. Banting eat and drank to their habitual diet.

Now the manner in which this kind of diet operated in reducing fat was two-fold; *first*, it cut off the main sources of extraneous fat, that is, the non-nitrogenous food, such as starch and sugar, as well as fat itself, and, *second*, it increased the oxidation of existing fat by the increased amount of nitrogenous matter, according to the results obtained by Pettenkofer and Voit. The danger that might arise would be that if the principle were carried too far, especially in persons with any hereditary tendency, gout and, perhaps, other serious diseases might be favoured. Reckless and indiscriminate experimenting on one's person is, therefore, dangerous; and this applies to many other things as well as diet.

When nitrogenous substances are used in the body, they are, of course, broken up and oxidised, or perhaps we ought to say more accurately, they take the place of the tissues of the body which wear away, and are carried off by oxidation and other chemical changes. Now, modern science tells us that such changes are accompanied with manifestations of energy in some form or other, most frequently in that of heat, and we must look therefore upon nitrogenous food as contributing to the energy of the body in addition to its other functions. But it would not do to depend upon this alone, for in order to obtain enough of energy we should have to take so large a quantity, that the body would be poisoned with excess of nitrogen. There is one other function that it seems to perform, and that is, in some circumstances to change into fat, which is useful in the system. This, however, is not its usual direction, and it is not to be depended upon.

What are the substances which we may class as nitrogenous? In the first place, we have the typical example of the purest form in *albumin*, or white of egg; and from this the name is now given to the class of *albuminates*. The animal albuminates are: Albumin from eggs, fibrine from muscles or flesh, myosin or syntonin, also from animal tissues, casein (or cheesy matter) from milk, and the nitrogenous substances from blood. In the vegetable kingdom, we have gluten, or vegetable fibrine, which is the nourishing constituent of wheat, barley, oats, &c.; and legumin, or vegetable casein, which is the peculiar substance found in peas and beans. All these substances resemble each other very much in composition, each containing about 16 per cent. of nitrogen, and the proportion of nitrogen to carbon being about 2 to 7. There are other substances than those named, but their quantities and importance are insignificant. All can nourish the human body, but the degrees of digestibility vary in the forms in which we meet them. Other nitrogenous substances are also met with, which are, however, only partially nourishing and require to be taken under peculiar conditions; of these the chief representative is gelatin, which is obtained from bones and other parts of animals, and the purest example of which is met with in isinglass, got from the swimming bladder of the sturgeon. Here we have too much nitrogen, relatively, the proportion being at 2 to 5½ of carbon, or as 4 to 11, whereas, in the albuminates proper, it is 4 to 14.

The other organic constituents—viz., the fats, and the starches and sugars—contain no nitrogen, and were at one time thought to be concerned only in producing animal heat. We now know, thanks to the labours of Joule, Lyon Playfair, Clausius, Tyndall, Helmholz, &c., that heat itself is a mode of motion, a form of convertible energy, which can be made to do useful or productive work and be expressed in terms of actual work done. The first to accomplish this important result was Dr. Joule, of Manchester, who, in conjunction with Dr. Lyon Playfair, first established what is known as the mechanical equivalent of heat. Practically, the fact was known long before, for the whole plan of the steam-engine depended upon the principle; but, like many familiar things, the exact bearing of what was seen every day was not fully recognised. Many years before, Count Rumford had caused water to boil by blows of a hammer, thus converting visible work into heat in precisely the same way as the axle-boxes of a railway train take fire when not sufficiently greased. When Joule and Playfair proved the converse of the proposition, that heat could be converted into a definite quantity of useful work, their mutual relations were completely established. They showed that heat, sufficient to raise the temperature of 1lb. of water 1° of Fahrenheit, was equal to work which raised 772lbs. weight one foot high; or, as it is generally expressed, equal to 772 foot-pounds. This is known as the English heat unit; but it is more usual, in scientific writings, to refer to the French or metrical heat unit, which is reckoned by the quantity of heat required to raise one cubic centimetre of water (about quarter of a teaspoonful) through 1° of centigrade (1°·8 Fahrenheit), and this is equal to work which raises 424 grammes weight (about 15 ounces avoirdupois) through 1 metre in height ($3\frac{1}{3}$ft.). An English heat-unit is thus equal to about 251 French or metrical units. When we come to deal with high numbers, it is convenient to have larger units of expression, and accordingly we often speak of foot-tons instead of foot-pounds, meaning the energy necessary to raise a ton through 1 foot. An English heat-unit is accordingly equal to about $\frac{1}{3}$ of a foot-ton.

Having these starting points, it is easy now to compare the work done by a man with the potential energy of the food he consumes. By potential energy, we mean the amount of energy which it is possible to obtain by oxidising or burning the material. Thus, if we take an ounce of white sugar and burn it thoroughly, we get, as a result, carbonic acid and water, beyond which no further oxidation can take place. And if we make arrangements to save all the heat and make it heat a given quantity of water, we find that its burning yields about 370 English heat units, which are equal, expressed in terms of work to 128 foot tons, or about $\frac{1}{70}$ of a horse power. In a similar way we know that an ounce of perfectly dry (water-free) albuminate yields about 173 foot tons, and an ounce of perfectly dry fat 378. I have already said that modern experiment showed that all our energy was derived from that of food, and, in particular, from the non-nitrogenous part of it, that is, the fat, starch, and sugar. Let us now inquire if those substances can replace each other partially or completely.

First, with regard to fat. There are various kinds of fat, such as butter, lard, oil, etc., and they have certain variations of composition and degrees of digestibility. But they all agree in an absence of nitrogen, the presence of a large quantity of oxidisable carbon, and also of a certain amount of oxidisable hydrogen. Fat enters into all diets and is eagerly sought for in all climates. It is most largely consumed in the Arctic regions, but the inhabitant of tropical Africa eats his palm oil, and the inhabitant of tropical India his ghee with great satisfaction. Fat is particularly required when considerable fatigue has to be undergone, and whenever exertion is increased to any material degree fat must be increased also. There is, however, a limit to the power of assimilation of fat, for after a certain point it is no longer received by the system, but passes from it unchanged. It provides a large amount of potential energy in a small bulk, one part being equal to two and a half parts of sugar. The other group of non-nitrogenous substances consists of the sugars and starches, represented by ordinary cane-sugar, milk-sugar, grape-sugar, and fruit-sugar; also, by honey and other sweet substances. The starches form the great bulk of the solid matter of wheat, barley, rice, potatoes, and the like. This group consists of substances quite free from nitrogen, and consisting entirely of carbon and the elements of water. The carbon is thus the only source of energy, for there is no unoxidised hydrogen; the group is generally spoken as the carbo-hydrates. They always form the greatest bulk of all diets, except those of the arctic peoples, whose geographical position puts most cereals and other vegetable food out of the question. We do not yet know what are the relative advantages of starch and sugar, or why one should be preferred to the other. All starch must be converted into a form of sugar before digestion is possible, and this is accomplished by the saliva; hence, the fatal error of giving starchy food to young infants before they have cut their teeth, and are provided with salivary apparatus to deal with it. An immense amount of fatal illness may be traced to this practice. On the other hand, the not very pleasant looking practice of mothers chewing bread and other food before putting it into the baby's mouth is really a salutary and scientific process, as doing for the child what it could not do for itself, if it must have such food.

But in spite of the necessity of this double digestion for starch, it is still preferred as food for adults to sugar, a much smaller quantity of the latter sufficing and an excess rapidly palling. The function of the carbo-hydrates appears to be to produce energy by their oxidations, either for use as animal heat or for conversion into useful work. It would also appear that by their deoxidation they can be converted into fat, and are, in fact, the main sources of fat in the animal body. Similar, however, as the functions of fat, starch, and sugar are, we do not find it possible to replace them by each other indefinitely,—each has some special advantage which has not yet been fully investigated.

There is another class of substances which are usually included in the carbo-hydrates, viz :—the vegetable acids, such as acetic acid, the acid of vinegar, citric acid, the acid of lemons, malic acid, the acid of apples, tartaric acid, the acid of grapes, and the like. These are concerned in preserving a healthy condition of the blood, and preventing the disease known as scurvy, of which I shall say a few words later on.

There still remains the class of salts or mineral matters consisting of those portions of food which cannot be destroyed by fire, and remain as ash, and of the common salt which we, most of us, if not all, add to our food. The chief constituents of this class are sodium chloride, or common salt, potassium chloride, and phosphates and sulphates of lime and magnesia and a little iron. These are just as essential as the articles of diet ; the chlorides are necessary in order to yield hydrochloric acid for digestion, and the phosphates of lime and magnesia are required for many of the tissues, but especially to keep up the bony skeleton or framework of the body. If they are omitted from the food the unfortunate victim becomes listless, weak, and ultimately succumbs, and if a change in the system should occur, as sometimes takes place, when the body cannot assimilate these substances a terrible state of things results ; the bones soften and give way, the whole countenance alters from the flattening of the bones of the face and head, and the patient dies sometimes from the mere pressure of the atmosphere, the soft and placid condition to which he is reduced giving no point of resistance from which the respiratory muscles can act.

The nutrition of man is best maintained when he is provided with a due admixture of all the four classes of aliment which we have mentioned, and not only that, but he is also better off if he has a variety of each class. Thus he may and ought to have albumin, fibrin, glutin, and casein among the albuminates, or at least two of them : butter and lard, or suet, or oil among the fats ; starch of wheat, potato, rice, peas, &c., and cane-sugar and milk-sugar among the carbo-hydrates. The salts cannot be replaced, so far as we know. Life may be maintained in fair vigour for some time on albuminates only, but this is done at the expense of the fatty tissues, especially the fat of the body, and the end must soon come: with fat and carbo-hydrates alone vigour may also be maintained for some time, at the expense of the nitrogenous tissues, but the limit is a near one. In either of those cases we suppose sufficient water and salts to be provided.

We must now inquire into the quantities of food necessary; and this necessitates a little consideration of the way in which the work of the body is carried on. We must look upon the human body exactly as a machine: like any engine with which we are all so familiar. A certain amount of work requires to be done, say a certain number of miles of distance to be traversed, we know that to do this a certain number of pounds, or hundredweights or tons of coal must be put into the fire of the boiler in order to furnish the requisite amount of energy through the medium of steam. This amount of fuel must bear a certain proportion to the work, and also to the velocity with which it is done, so both quantity and time have to be accounted for. But there is this remarkable difference between our body and a mechanical engine that when the latter is at rest there need be no expenditure of fuel in any way, and if it does get out of order its work must be suspended in order to repair it; but in the human body we have a continual wearing away of the machinery, and an equally constant repair going on, without necessarily arresting the useful work, and while the body is at rest there must be a certain amount of expenditure to keep it together at all, which expenditure is manifested chiefly as animal heat. We have thus to consider two directions which the potential energy of the fuel of the body, that is, the food, may take; one, the more important and the one involving the largest expenditure, which has to do with the very existence of the body itself, and the other, the useful or productive work which the body can do. Every engineer knows only too well that he can never get back as useful work anything like the amount of energy which he puts in as coal into his engine, and he also knows that the apparent loss is greatly increased with increased velocity of working, in something like the cube of the rate of work. It is exactly the same in the case of man's body, for, even after so much provision has been made for animal heat and the internal work of our frame, we cannot get more than one-fifth of the additional potential energy supplied in food as really visible and useful work. When we increase the velocity of the work the proportionate amount diminishes still more, although the actual ratio is still somewhat obscure.

In speaking of quantities of food, it is necessary to explain that we must consider primarily the amount of water-free constituents. Every article that we eat, with the exception, perhaps, of perfectly dry crystallised sugar, contains some water, that is, water actually in the state of moisture which can be dried off by means of heat, without breaking up and destroying the essential composition of the article in question. The amount of water, of course, varies very much, the largest amount being found in succulent vegetables, and the smallest in flour, biscuit, butter, sugar, &c. In every pound of bread we get about *ten* ounces of solid matter and *six* ounces of water; in every pound of butcher's meat only four ounces of solids and twelve ounces of water; the same in potatoes; whilst in cabbage and such like vegetables we get only two ounces of solids to fourteen of water. In fact, in such vegetables there is more water than in good milk that has not had any clandestine dealings with "Simpson," the commercial euphemism for water. Taking the general average of diet, rather more than half (60 per cent., in fact), of what we call solid food, consists of water, and, therefore, in calculating a diet out carefully, we must have some knowledge of the composition of the articles and the amount of water each contains. When, therefore, we speak of so much albuminate, fats, carbo-hydrate, and so on, we speak of those constituents as theoretically free from water, and in order to arrive at the gross weight of food in its ordinary condition we must add once-and-a-half more weight for the water that would be contained in it. Thus: if we decide that a man must have 20 ounces ($1\frac{1}{4}$lb.) of water-free food daily, we know that we must add as much as 30 ounces more for the weight of water that would be found naturally in the food, so that the total weight of his rations would be 50 ounces or rather more than 3 lbs., only $1\frac{1}{4}$ lb. of which would be really solid.

Let us now inquire what quantity of the water-free solids is necessary. Lyon Playfair has carefully calculated the amount that would be sufficient to keep a man of average weight alive in absolute repose, the total amount being 15 ounces, representing about $2\frac{1}{4}$lbs of ordinary food. In a state of rest, that is, not absolute repose, but using no active exertion, 16 ounces are required, representing about $2\frac{1}{2}$lbs of ordinary food. Of this water-free food $2\frac{1}{2}$ ounces are albuminates, 1 ounce fat, 12 ounces carbo-hydrates, and $\frac{1}{2}$ ounce salts. This is found to be necessary to keep up the internal work of the body, such as the beating of the heart, the breathing and the various chemical changes that go on, and to supply animal heat. In short a man requires about $\frac{1}{150}$ of his weight in water-free food, or about $\frac{1}{60}$ of ordinary food every day, in order to keep alive, and not lose weight,—provided he is not called upon for active work. Some may be inclined to remark upon this, that cases are known where men have lived for a long time on much less, and other instances, more or less authentic, where people have gone on for long periods on nothing at all. We have the celebrated case of Dr. Tanner, who professed to live for 40 days without anything but water, whereas, according to Playfair's calculation, he ought to have consumed about 100lbs. of ordinary food to keep himself alive. It is difficult to discuss a case which has not been watched with scientific precision, but we have facts independently, which show that men can under special conditions, live a long time on very small quantities of food, not certainly without losing weight, but still without succumbing altogether. One essential condition is a warm temperature, or at least protection against the radiation of heat from the body. We must, however, bear in mind, that such cases, if they are authenticated, are the exception and not the rule, and in laying down laws for general guidance exceptions cannot be regarded.

There are two or three ways in which we may approach the question, besides that of direct experiment. For instance, when the chemical changes go on in the body, the carbon is converted into carbonic acid, the greater part of which is given off from the lungs, just as smoke, &c., are given off from the chimney of a furnace. Now it has been ascertained that in a state of rest a man of 150lbs. weight (10 stone 10lbs.) gives off about $15\frac{1}{4}$ cubic feet of carbonic acid every 24 hours. Now each cubic foot of carbonic acid is evidence of the expenditure of 160 foot tons of energy, and $15\frac{1}{4}$ multiplied by 160 gives us 2440 foot tons total energy per diem. Again, if we examine the temperature of the human body we find that it is normally 98°·4 Fahrenheit, whereas the average of the air is not above 50° F., indeed, here in Newcastle it is lower than that, about 48° I think. Let us take the difference, however, at 48°F., and suppose that the 150lbs. of man's body absorbs heat in the same ratio as water, and it actually does contain 90lbs. of water; we shall find $150 \times 48 \times 775 \div 2240 = 2481$ foot tons of energy expended, a difference of only 41 foot tons from the calculation by the carbonic acid, or less than 2 per cent. If now we turn to the food calculated by Playfair we find the following amounts of potential energy—

Albuminates, $2{\cdot}5 \times 173 = 432$, Fat $1 \times 378 = 378$, and Carbo-hydates, $12 \times 138 = 1656$, total 2466 foot tons.

The correspondence between these three numbers is remarkable, and, even allowing for error, it goes far to prove the accuracy of Playfair's induction.

But the end of man is not to lead a merely vegetative life:

"What is a man,
If his chief good, and market of his time,
Be but to sleep and feed? A beast, no more."

He must be up and doing and produce some actually visible work. This, however, he can only do if the necessary energy is supplied to him through food. Let us first consider what amount a man usually does. Suppose a man wields a hammer of 14lbs. weight, and that at each stroke he raises it 4ft., then each stroke is equal to 56 foot pounds, or $\frac{1}{40}$ of a foot ton: therefore, 40 such strokes will equal 1 foot ton. A fair day's work will be about 12,000 strokes, or 300 foot tons. But work is frequently greater than this: a man has been known to raise a weight of 90lbs. a foot and a half, 12,000 times in the 24 hours: this is equal to 723 foot tons. Usually, however, for average men, the maximum is 600 foot tons, and even that cannot be carried on for more than a limited period. The estimate is generally as follows:—

Light	work	150	to	200	foot tons per day.
Average	,,	300	,,	350	,, ,,
Hard	,,	450	,,	500	,, ,,
Laborious	,,	500	,,	600	,, ,,

What such work means will, perhaps, be better understood by stating the distance it corresponds to in walking. It has been ascertained (especially by the Rev. Dr. S. Haughton, of Dublin) that ordinary walking, at about three miles an hour, is equal to about $\frac{1}{20}$th of the work done against gravity in raising up the body perpendicularly; say, mounting a perpendicular ladder. Therefore, a man who weighs 160lbs. (11st. 6lbs.) in his clothes, walking on level ground, does, for every mile of distance, nearly 19 foot-tons; hence, a light day's work would be from 8 to 10 miles, an average day's work from 16 to 18, a hard day's work from 24 to 27 miles, and a laborious day's work from 27 to 32 miles. Few men would, I fancy, care to walk 30 miles a day for six days a week continuously. Of course, if additional weight is carried, this must be taken into account.

Again, if the rate or velocity is increased, we must account for that also; for every mile of additional velocity per hour the resistance is increased by about one-fourth, so that the work per mile done is increased in this proportion, four miles in one hour being equal to five miles done in an hour and forty minutes. Long-continued exertion, even at moderate rates, tell also severely. The extraordinary feats performed by professional pedestrians, such as Weston, Gale, O'Leary, and others, are very severe, and must tell seriously on the constitution. I have calculated out some of the work done on these occasions. When Weston and O'Leary walked six days against each other, the former did about 1750 and the latter over 1900 foot-tons every 24 hours; Gale, who walked 1500 miles in 1000 hours performed an enormous feat of endurance, amounting to 560 foot-tons per diem continuously for six weeks. But the work per man of the sledge parties in Nares' arctic expedition was even greater and done under the most adverse conditions. It is quite clear that this energy expended must come from somewhere, and it ought properly to come from the food; if it does not, then it comes from the framework of the body itself. Helmholz has shown that, for ordinary work, an amount of food must be given (over and above that for existence) which is equal to *five* times the amount of potential energy expended in useful work. Thus, for a day's work of 300 foot-tons, an addition to subsistence-diet must be made equal to 1500 foot-tons. If the work is harder, the proportion must be still greater; so that, for a hard day's work of 450 foot-tons, we must give the equivalent of nearly six times, and, for 600 foot-tons, seven times, the visible energy expended.

As a general rule for average work, we obtain about $\frac{1}{14}$ to $\frac{1}{13}$ of the total energy, given in the shape of food, returned as useful work. The standard diet for average work is generally accepted as the following:—

Albuminates	4·6	ounces.
Fat	3·0	,,
Carbo-hydrates	14·3	,,
Salts	1·1	,,
Total	23	ounces water-free.

This argues about 3½lbs. of ordinary so-called solid food, and would yield 3878 foot-tons of energy, which gives 1438 for the useful work, slightly under the required amount. Accordingly this diet would be improved by a slight increase in the fat, and this increase is actually made in the diet proposed by Pettenkofer and Voit. There is another thing that must also be remembered, and that is, that all the material is not thoroughly used up, that some portions escape oxidation, like the cinders of a coal fire, so that a margin of ten per cent. may fairly be allowed to make up for this. When the work is increased so must the food be, chiefly in the direction of albuminates and fat. Sometimes the result is stated as nitrogen and carbon, in the proportion of 300 grains of nitrogen and nearly 5000 of carbon: it is safe to allow one additional grain of nitrogen and sixteen of carbon for every additional foot-ton of work. By carefully apportioning food to work it will always be easy to get the best results; but if this be neglected failure and disappointment result. It was to neglect of this fact that we owed the deaths of so many victims in the great famine in Madras a few years ago; and the mistake is still made in the dieting of our soldiers, our prisoners, and others in public institutions. A glance at the diets of different armies will show at once their deficiencies compared with the standard diet. They are all deficient in albuminates and fat, and have an excess of carbo-hydrates.

DIETS OF EUROPEAN ARMIES.

	English.	French.	Prussian.	Austrian.	Standard.
Albuminates	3·86	4·33	4·02	3·73	4·6
Fat	1·30	1·27	1·09	1·64	3·0
Starches	17·43	18·04	19·62	17·00	14·3
Salts..................	·81	1·00	1·50	1·00	1·1
	23·40	24·64	26·23	23·37	23·0

It is curious to observe the marked deficiency in fat, and nearly in the same proportion in all the armies. In our country the soldier often supplements his somewhat deficient diet from his own pay, but abroad the French or German soldier cannot do much in that way, his pay being much smaller. The Austrian soldier has, however, some additions, such as garlic, onions, vinegar, &c. When war breaks out a very material change is made, and an increase provided commensurate with the increased exertion demanded.

Much controversy has taken place on the subject of vegetarianism, and almost as much heat has been imported into it as in a religious discussion, the *odium theologicum* having its counterpart in the *odium dieteticum*. We have seen that the vegetable kingdom furnishes all the necessary constituents for a nourishing diet, but the question is chiefly one of habit and digestibility. The most nourishing vegetable matter is peas or beans, which, weight for weight contain more nitrogen than meat. But they soon pall upon the appetite and produce indigestion. The Germans found this with their celebrated pea-sausage in their late campaigns. Wheat, oatmeal, and maize are all nutritious, but they contain too much starch to provide a thoroughly good diet alone. But the great difficulty of a vegetable diet in a cold climate is the want of fat; in warm countries oil easily supplies this, but in cold countries there is hardly any vegetable which yields fat in any quantity, except rape-seed, linseed, mustard-seed, sun-flower seed, and the like, and none of these oils are very attractive as articles of diet. As for the people who call themselves vegetarians, and yet make free use of milk, eggs, cheese, and butter, I have nothing to say, except that they are sailing under false colours; they are not vegetarians, but mere abstainers from flesh meat.

The question of dried, concentrated, and preserved food is one of great importance. Some mistakes have arisen with respect to these, people occasionally imagining that a day's ration may be concentrated to the size of a lozenge and the like. Now this is absurd: we can only concentrate food by driving out the water, and we have already seen that an ordinary day's ration must consist of at least 23 ounces of water-free food, so that about 1½lbs. is the absolute limit of concentration or drying. Even this can hardly be reached, for if we dry up food to this extreme extent, it becomes quite indigestible, and consequently, not only useless but hurtful. The most concentrated food known is probably pemmican, the food so much used by Arctic voyagers; and even this contains about 7 per cent of water. Preserved food, on the other hand, is food preserved from decay in its natural state, without any loss of water. The whole system of preserving and keeping food is now being brought to great perfection, and the improvements that are daily made will prove the greatest boon to all classes, by enabling us to store food that would otherwise be wasted, and generally by cheapening, and making nutritious and palatable, the diet of the poorer classes.

No lecture on diet would be complete without a reference to the vexed question of alcohol. I am no teetotal advocate, and I repudiate the rubbish too often spouted from teetotal platforms, talk that is, perhaps, inseparable from the advocacy of a cause that imports a good deal of enthusiasm. I am at one, however, in recognising the evils of excess, and would gladly hail their diminution. But I believe that alcohol properly used may be a comfort and a blessing, just as I know that improperly used it becomes a bane and a curse. But we are now concerned with it as an article of diet in relation to useful work, and it may be well to call attention markedly to the fact that its use in this way is very limited. The experiments of the late Dr. Parkes, made in our laboratory at Netley, were conclusive on the point, that beyond an amount that would be represented by about one-and-a-half to two pints of beer, alcohol no longer provided any convertible energy, and that therefore to take it in the belief that it did is an error. It may give a momentary stimulus in considerable doses, but this is invariably followed by a corresponding depression, and it is a maxim now generally followed, especially on service, never to give it before or during work. There are, of course, some people who are better without it altogether, and to all moderation ought to be commended, if not enjoined.

There are other beverages which are much more useful than the alcoholic, as restoratives and for support in fatigue. Tea and coffee are particularly good, although their use is sometimes carried to excess, as, for instance, in the ridiculous practice of afternoon tea, which has become so fashionable of late years. Another excellent restorative is a weak solution of Liebig's extract of meat, which has a remarkable power of removing fatigue. Perhaps one of the most useful and most easily obtainable is weak oatmeal gruel, either hot or cold, the value of which has often been found during heavy and continuous work, by railway labourers and others. Particular attention was called to this by the late Dr. Parkes. With regard to tobacco, it also has some value in lessening fatigue in those who are able to take it, but it may easily be carried to excess. Of it we may say, as of alcohol, that in moderation it seems harmless, and even useful to some extent, but, in excess, it is rank poison.

There is one other point which I must refer to, and which is especially interesting to a great seaport like this. This is the question of scurvy, a question of vital importance to a maritime nation. When the human body is in a state of health the blood is alkaline, and the juices of the flesh are acid. Under these circumstances galvanic currents are the normal result. Whether these be necessary or not it is quite certain that this relative condition is essential for health. Under certain circumstances this alkalinity of the blood becomes diminished, and then a terrible train of symptoms sets in; the blood becomes very fluid, and loses the power of coagulating: it exudes through the walls of the vessels and appears in red and purple patches on the limbs, the gums become spongy and bleed, and the teeth loosen and drop out, the eyesight is impaired, diarrhœa sets in, and if crowding and starvation are added, typhus shows itself with fatal results. Any one who has seen such a stare of things can never forget it.

I have a most vivid recollection of the first winter of our Crimean Campaign, which I passed in the hospitals at Scutari, where scurvy and typhus carried off both officers and men. Scurvy was the dreaded scourge of our fleets in the last century, and again and again went nigh to compromising our position as a naval power; the Channel Fleet used sometimes to return hopelessly crippled with 10,000 sick and useless on board. Although in the work of Woodward, in the 17th Century, the value of acid fruits were pointed out, and although more than a century later Captain Cook had practically proved their efficacy, it was not till 1796 that the authorities would listen to the remonstrances of the medical officers of the fleet and issue lime-juice. But when it was done the effect was magical; scurvy disappeared like a troubled dream, and the gastly demon of former days was most successfully exorcised.

From that time down to the present, the issue of lime-juice has been compulsory on board our fleet, within certain fixed periods after the issue of fresh meat and vegetables has ceased. It is also a regular part of the equipment of any land expedition. The consequence has been that scurvy has been unknown in our fleet; except, on Arctic expeditions and such exceptional occasions, for all this century. But it still made its appearance from time to time among our merchant shipping. An act was passed, however, in 1867, called the Merchant Shipping Act, which enjoined the issue of lime-juice to ship's crews after they had been a certain time on salt provisions. This Act was followed by amended improvement, for, whereas in 1867 and 1868, there were respectively 88 and 90 outbreaks of scurvy among British ships, there were only 22 in 1869, and 19 in 1873.

A paper lately issued by Mr. Thomas Gray, of the Board of Trade, discloses the regrettable fact that since 1873 there has been a serious falling off, the outbreaks of scurvy having again increased until they reached 99 in 1881. This, Mr. Gray seems to think, is due to a neglect of varied food scales; but it may also very probably have arisen from the neglect of the regulation about lime-juice, either as to issue or quality, or both. But it is also a fact of very great importance that mere monotony of diet has a most serious effect upon health; variety of food is not merely a pandering to gourmandism or greed, but a real sanitary benefit, aiding digestion and assimilation. As a habit there is too much neglect of green vegetable food in England, particularly in the more southern parts, where bacon and beans form a staple part of diet. In the north, and still more in Scotland, vegetables enter much more largely into the daily food, and no more wholesome and anti-scorbutic food could be found than Scotch broth, or, still better, hotchpotch, the very prince and king of soups. It is a curious fact that this culinary defect has clung to the English name for centuries.

It is on record that, at the siege of Breda, in the seventeenth century, where the English were engaged alongside French and other troops, they (the English) suffered from scurvy and dysentery much more seriously than the others, due, it was believed, to their neglect of vegetable food and to their drinking brandy or other spirits, whilst their allies drank red acid wine. Many of the earlier campaigns in France were marked by the same thing; and this was, probably, one of the causes of the sickness of Henry the Fifth's army in the campaign of Agincourt. Again, the sailors of the French and American fleets have never suffered from scurvy to the same extent as ours; and it was not till sixty years after the introduction of lime-juice into our fleet that it was thought necessary to make similar regulations in the fleets of other countries. The Americans used to taunt our men with this, and call them "lime-juicers."

Now the reason of all this has been that the diet has been much more varied and more thoroughly antiscorbutic in foreign vessels, particularly in their merchant ships. The actual amount of nutriment has been as large in our ships, but it has been less varied and less judiciously arranged. Our Board of Trade has nothing to do with the food scales of ships, but Mr. Gray hints that the legislature will have to interfere unless ship-owners look to it themselves. The ease with which preserved foods of all kinds can be obtained and carried now removes the last shadow of an excuse for backwardness in this matter, and in particular the provision of a large supply of potatoes, both fresh and dried, ought to be an unceasing care; this is done on board American ships, and to this is doubtless owing in a great part the healthiness of their crews. Scurvy in the present day is a disgrace to ship-owners and masters, and if public opinion is insufficient to protect the seaman the legislature will undoubtedly step in and do so.

And now, ladies and gentlemen, let me close this, I fear, rather prosy lecture, by pointing out that the study of this common-place matter of eating and drinking opens out to us the conception of the grand unity of nature; since we see that the body of man differs in no way essentially from other natural combinations, but is subject to the same universal physical laws, in which there is no blindness, no variableness, no mere chance, and disobedience of which is followed as surely by retribution as even the keenest eschatologist might desire.

THE NEXT TO GODLINESS.

AN ADDRESS TO THE WORKING CLASSES

By Benjamin Ward Richardson, M.D., F.R.S.

J. COWEN, M.P., IN THE CHAIR.

When the man of genius who represents the city of Newcastle ceased to speak, I was reminded of the remark which was applied by Ben Jonson to Lord Bacon, namely that when Lord Bacon spoke there was only one anxiety amongst the people who were present, and that was that he would too soon stop. Now Mr. Cowen has ceased, and it is my duty to take up the discourse. I have been invited to give a lecture to Newcastle working men, and I am going to do so, in that sense, strictly. It is not uncommon for public men in speaking to working men and women of the country to begin by saying insinuatingly and sweetly that they, the speakers, are also working men. The working listeners listen, and sometimes out of their politeness and good humour applaud the remark, while at the same time they know perfectly well what it means. I shall not follow that course, but shall define what I mean as the working classes to be the men and women who, in the fields, the workshops, and the factories, labour with their hands and receive wages for their labour, an audience, if one could reach the whole of it,. the greatest, numerically, attainable.

The national family of England and Wales, reckoned when it was about 25 millions, stood nearly as follows:—Eight millions were children, six were women and others of the household, domestic people, making 14 together. One million was a commercial class, buyers and sellers, making 15. One million was a ne'er-do-weel class, persons in the workhouse, the prison, or asylum, 16. One million was an independent or professional class, politicians, clergymen, doctors, lawyers, soldiers, sailors, artists, or some other salaried, fee'd, or wealthy individuals who belonged to what is called the ruling body of the nation, 17. Two millions were workers on the land, 19; and six millions were workers in the shops, factories, and other centres of work, the industrials of the people, making up the 25 millions. The two last-named classes are, then, what I understand as the working classes; they, with their wives and children, made up more than half of the nation, and their men stand in such large proportion in number to the men of all the other classes, that they are, in very truth, the masses. It is to some of them I speak.

A Message from Mr. Chadwick.

A great living sanitarian has written to-day, asking me to lay before this audience certain important general truths respecting sanitation, an outline of which I will read. The distinguished man who sends you this message through me is he to whom your Chairman has referred, and from whom he has quoted, Mr. Edwin Chadwick, our veteran of veteran sanitary reformers. In brief, these are the facts he wishes me to tell you.

"Tell them," he says, "all you can, from what you see and know about their excess of sickness, pain, premature decay, working failure, and early mortality from causes they know nothing of, because they have been told nothing honestly and clearly respecting them.

"Tell them how their vigorous exertions, even silently expressed, would assist those who are labouring to rescue mankind from these penalties.

"Tell them that the most racking of diseases, rheumatism itself, ascribed so commonly to some obscure cause and accepted as inevitable, is, as ague once was, most often due to bad sanitary laws which permit of imperfect subsoil drainage and damp habitations.

"Tell them that even toothache may be due to bad local or general legislation.

"Tell them that they are scourged with typhus and other plagues from the same errors, by the failure to get the pure air in which these plagues will not live.

"Tell them that of children of the poorer classes, born in lawful wedlock, one-half die before they have reached their sixth year from the operations of bad sanitary regulations.

"Tell them that 50,000 innocents in these islands thus go annually to their graves, as if under the hand of an ever living Herod.

"Tell them that schools, which ought to be centres of health are centres of disease, owing to administrative faults and regulations, elaborated for the inspectors of schools. Tell them that when they hear of that disease called *consumption*, from which so many thousands die each year, and which they think comes 'like the arrow which flieth in the dark,' they ought to know that it comes constantly from bad administration, which permits dwelling-houses to be built on damp, and sodden, and rotten sites, and which permits industrial workers to breathe, but not to live, in foul airs, gases, vapours, and dusts.

"Tell them that a prediction, based on scientific data, and made half a century ago, has been fulfilled, namely, that in model dwellings a death rate of 15 in the 1,000 has replaced one of 30 in the 1,000.

"Ask them whether they do not think that labours which lead to such saving of life do not deserve as ample recognition as those labours, however skilful, which lead to the destruction of life.

"Implore them to let the subject of the freeing of life from its useless and hard penalties of disease, pain, and death, have some place in their future political programme."

The Present Text. The next to Godliness.

These are words which Mr. Chadwick sends, and I could easily have based a lecture on any one of the passages I have read. His suggestive texts came, however, too late, for before they came to hand I had selected my own text, and that text is —"The Next to Godliness." I need not tell you that this means cleanliness, for the statement, "Cleanliness is next to godliness," is a common proverb. Some hold the statement as of Biblical origin, but it is not so. Others attribute it to the famous John Wesley, who, perhaps, put it into the terse form in which it runs; but it is ages older than Wesley, for it came down to us in the Tractate Sota of the Mishna, an old Jewish book, where it reads, "Outward cleanliness is inward purity."

These are grand words, words worthy of any occasion when men and women assemble to discuss or to study life, and health and life through health. If by some magic spell England could wake up to-morrow, clean,—as I shall define that term,— she would wake pure also in spirit and godly in the comprehension of goodness. Cleanliness covers the whole field of sanitary labour. It is the beginning and the end. Practised in its entirety, it would banish all disease from the world. Where shall it begin?

Like charity, cleanliness must begin at home. An observant physician entering a house in which there is disease, looks around and questions from the house the character of the residents of it in regard to health. If he finds that order prevails everywhere there, and that cleanliness prevails everywhere there, he is satisfied that his efforts will be well seconded, and that they will have a good chance of being attended with success. But if he finds disorder there, and with disorder uncleanliness, then he feels anxious doubly anxious, about what will happen to the person who is under his care, because almost of a certainty many valuable chances of success will be lost.

Personal Cleanliness.

Cleanliness I say then should begin at home, and it should begin there with the persons themselves who make up the home. The body of man, in order that it may be kept in perfect purity and health, must be daily cleansed by ablution. All the vital functions of the body are benefited by this one yet simple act. The skin, the lungs, the blood, the circulation, the liver, the kidneys, the brain, and even the senses are all in functional sympathy, and if the one be out of working order the others will be. If the skin is severely irritated or injured and is in severe pain over its surface, all parts of the body will suffer more or less ; and if the skin be not free to perspire, if it be covered with dust and cast-off parts of itself, again other organs suffer. The skin relieves the lungs of much work. It casts off watery vapour, and it casts off some gases which are of the same nature as the gases exhaled by the lungs. To reduce therefore the functional activity of the skin, is to throw more work on the lungs. To throw more work on the lungs is to interefere with the proper airing, or to speak technically, æration of the blood. To interfere with this vital change in the blood is to reduce activity everywhere ; is to make sluggish the action of the stomach, the liver, and other secreting organs ; and is, in turn, to make dull the brain and lessen the mental activity. See then how immensely important a thing it is for health, to keep the skin, at every point and pore, ready for work.

In urging this practise of cleansing the surface of the body, expensive and luxurious appliances are not required. A gallon of pure water, a wash-hand basin, a shallow tub to stand in, a lump of soap, and a large clean towel are all that can be wanted for daily ablution. There are few so poor who cannot afford these few things, and the experiment always pays in the increased health, happiness, and vigour which it brings. This habit of daily ablution should be taught to the young from their earliest life. It then becomes a habit—a second nature—and the day does not seem to have been duly commenced until it has been carried out. Of the benefits which follow this daily ablution too much could not be said. In schools where the practice is faithfully adopted, the results are an all-sufficient answer for its utility. Connected with this matter of personal cleanliness, the teeth must not be forgotten. A good set of natural teeth is invaluable; invaluable for appearances sake, for speech, for ease from suffering, and most of all for good digestion. But one of the great causes of disease and decay of the teeth is uncleanliness. The teeth should be brushed every night and morning—not with a brush hard as a scrubbing brush, for they are refined and precious structures—but with a soft brush, which cleanses thoroughly and leaves no scratch or friction.

Cleanliness of Dress.

Health will not be clothed in dirty raiment, and dress, which is the first possession a man or woman holds, and which is the first thing they are put into, should be cleanly as the body which wears it. No doubt to men and women who have to work in much uncleanliness, this is not easy; but in fact the differences that are seen in different individuals engaged at the same occupation, and how clean one often is compared with others, show that the difference between cleanliness and uncleanliness is, after all, very much a question of habit, and that when the cleanly habit prevails it is even more easy, as it is more healthy, than the uncleanly. Clothing should be purified, not only by washing and brushing, but by ventilation also. When removed from the body at night it should be turned inside out and suspended in the air. We cannot flatter our French brethren very heartily by imitating them in the matter of personal cleanliness, but there is one custom amongst the industrial classes of France which it would really be wise to copy; namely, the use of the blouse or over-covering, which they put on when they are at work. The blouse not only keeps all clean beneath it, but it preserves from wear, and when it is made of strong homely material, is an economy of singular value.

Cleanliness in the House.

Cleanliness in the house is the next topic to be dwelt upon. A clean home is a pleasant home a thrifty home and a healthy home. Cleanliness in the house means, first and foremost, cleanliness of light. No house can be clean that is dark; no dark room can be kept clean, for dirt must be seen to be removed. "Let there be light," is said to have been the first command, and truly no command should ever stand before it or bar its way. Last century the purblind statesmen who preferred taxation at all costs to health at no cost, shut out the light from British houses, and thereby brought in diseases like a flood. Pure light purifies; destroys the organic poisons of spreading diseases; makes a cheerful countenance; gladdens the heart, causes the blood to flow quickly, brightly, and of natural hue. Plants, the universal purifiers for man, taking up his breath, living on his breath, and giving it him back again in food produce, sicken and die if they have no light, but live and grow, and grow rich in the waves of this their natural inheritance. More light! more light! exclaimed the dying German poet Goethe. More light! more light! exclaims the sanitarian as he looks on the masses that are dying prematurely in large dense populations, and touched by him "who is clothed with light as a garment," sighs with them over their sorrows, sufferings, and oppressions.

To cleanly light, should be added clean water in the house, for impure water is a bearer of disease. No fact of modern science has been more decisively proved than this one about water, and the danger of having water for domestic use that is charged with organic matter. By impure water many of the most fatal diseases may be carried. Cholera has been carried by it, in what may be considered, a wholesale carrying. Typhoid has been carried by it, and quite recently I have had to trace a most severe outbreak of this disease, typhoid, to an impure water with which utensils used in a dairy were washed, and which was added to milk supplied to families that were fed with milk from that dairy. The poison of the disease was distributed by that supply. Each householder ought, therefore, to insist on having pure water in his household, and in having it in what is called constant supply; not stored up in tanks and cisterns in the house over water closets and other impure places; not stored up at all, in fact, but laid on direct from a main reservoir in which it is held in a perfectly pure and wholesome condition, containing no substance that can produce disease.

To make assurance doubly sure, it is well to have in every house a good charcoal filter. This filter every working man can make for himself who can burn charcoal, grind it into a coarse powder, place it in a barrel or earthenware reservoir, so as to make it a filtering bed a few inches thick, and put a tap underneath for drawing off the water that has passed through the purifying substance. I have seen some of the most simply constructed filters of this kind answer the purpose for ordinary filtration admirably. I do not wish you, however, to infer that when a household water is charged with organic substance mere filtration will remove that. It will not. But boiling will; and so if your water be even bad, it can be rendered serviceable by boiling it first and then submitting it to the filter. In times of danger this is neither hard to remember nor to carry out.

To cleanliness of water in the house must be added cleanliness of the air which is contained in the house. In towns like this I know how hard it is to keep the air of a house pure. I know well how dust and dirt will force their way in. I know how in close rooms, in small rooms, in rooms built for working men and women on bad plans, it is almost impossible to keep the air pure from what is cast off by the bodies of those who live in them. And yet a great deal can be done. The great point, even in a town such as Newcastle, is to let in the air freely from without, and to encourage it freely to depart by the chimney flue through an opening as near to the ceiling as can be obtained.

Keep ever in mind, then, these three necessities of cleanliness—clean light, clean water, clean air.

Cleanliness in Food and Feeding.

Let these suggestions respecting cleanliness suggest others, and of all two others: I mean cleanliness in food and feeding, and cleanliness in work. There is a common saying that every man must in his lifetime "eat his peck of dirt." Don't accept or believe it, for there is no must in the question. A man may do so, and perhaps many men do; but *must!*—not a bit of it. Every thing that is taken into the body should be clean, clean from elements of disease, clean from elements of dirt. Every utensil from which food is taken should be clean; every cloth used for cleansing and drying the utensils should be clean; every drop of water used for cleansing cooking utensils, as well as for cooking itself, should be clean. I need not tell practical people like you how to be clean in cooking, for you know how as well as I; but there is one matter bearing on the practice which I must mention. I am bound to name a custom or fashion which I notice amongst working men in the Metropolis, where I live, and which I fear is a custom carried out here. I hope it is not, but I fear it is. This is the fashion. If I go out in the early morning, and meet working men going to work, I see it every morning. I see these men trudging away to work, each man carrying his dinner, and it may be the whole of his food for the live long day, tied up in a cotton pocket handkerchief. I have seen worse than this. I have seen this food so tied up, this food which is about to become the bone, the flesh, the blood of the man who owns it, put on one side in the workshop, anywhere; tied to the steps of a ladder; cast on a bundle of shavings; hidden away in a corner; as if it were the last thing that had to be considered.

Well, I tell you, plainly, that all such negligence is uncleanly and wrong; wasteful and uncleanly. It is one of those destructive and thoughtless proceedings which occur not from necessity, but from sheer want of thought. Food, the best of food, treated in such a manner, becomes dry, hard, tasteless, indigestible. Food, the best of food, so treated is exposed to endless impurities, and is a source afterwards of actual danger. I should, therefore, be doing a very useful service if by this lecture I could make a reform in only this one particular. Indeed, I should be fully content to win this single point alone. At the same time I do not feel that it is asking much to beg for it. There is not one working man who could not at a very little cost of labour and money make for himself a light basket cleanlily lined for carrying his own food, which again I call his own bone, flesh, and blood. In the end the cost, too, would quickly be saved, for there would be saving of food from the very outset of the reform.

Cleanliness in Work.

Cleanliness in working at some special occupations is another part of the gospel of cleanliness which must be particularly called to remembrance. I could fill up my lecture, and a long lecture, in treating on this subject, so many things crowd on my mind; but I will confine what I have to say to two observations. There are great numbers of working men and women who work exposed to dusts, such as flax dressers, as pearl cutters, knife grinders, glass-paper makers, stone cutters, and the like. These draw into their lungs fine particles of dust, and in that way induce some of the most painful and fatal of human diseases. The diseases are induced because the air taken into the lungs of the workers is not cleared or cleansed of dust. The fault is the fault of the worker to a large, if not the whole, extent of the evil, for most effective and simple plans have been invented to exclude the dust. I have invented a mask for this purpose; Mr. Baker has invented a mask; and many others have done the same. In the days of the corn law rhymer, Ebenezer Eliot, Messrs. Abraham and Eliot invented for the knife grinders a magnetic table, which drew the fine particles of steel dust to itself. Here are methods which one would think all would follow. Will they? Not at all. In Eliot's time the aid was so slighted that in lines piteously plaintive he was led to write two of the most touching historical verses in our mother tongue.—

> "There draws the grinder his laborious breath,
> There, coughing, at his deadly trade he bends:
> Born to die young, he fears nor man, nor death—
> Debauch and riot are his bosom friends.
>
> "Yet Abraham and Eliot,—both in vain,—
> Bid science on his cheek prolong the bloom.
> He will not live! He seems in haste to gain
> The undeserv'd asylum of the tomb,
> And, old at two-and-thirty, meets his doom."

To this day some similar evil spirit of carelessness or opposition stands in the way of succour to those who still die from inhaling the air charged with dusts. Of those who are engaged in flax-working in Belfast district, Dr. Purdon, one of the certifying surgeons under the Factory Act, reported but a few years ago that in the factories under his care, if a girl, wishing to be a "carder," gets a card under eighteen years of age, she very rarely, if constantly employed at her work, lives beyond thirty years. In a statement of this kind there is something so grimly fearful, the mind is astounded as it receives it, as it takes in the further fact that the least objection made by the worker to the mask, or other preventive measure against the fatal uncleanliness which is the cause of all the suffering and death, is sufficient to prevent the continued use of the preventive measure, however easy it may be to use, and however effective may be its use.

I press these facts on your attention, with the hope that the reflection they may engender may help to dispel objections that have their origin in mere sentiment, and are beyond anything I can say, in addition, opposed to all progress in the way of reform.

The other evil to which I refer as bearing on uncleanliness in work, has reference to the unnecessary dangers in which those workmen and workwomen are exposed who are working in lead. You are as conversant with these dangers as I can be. You know that some suffer from lead colic, others from palsy, others from a kind of wasting or consumption, and that many die. Perhaps you know also, from what you have seen, that some who suffer disease from lead transmit the disease caused by the lead poisoning to their offspring. I need not dwell on these evils; they are too well known. I will therefore dwell only on the mode in which the evil is most commonly produced. The lead is supposed by some, to be absorbed into the body by the skin from the solutions in which the lead exists, and the view may be true.

But I have found by an enquiry I once made, that the absorption of the lead is much more frequently by the mouth. The worker is not cleanly at his work. He goes from his labour, his hands imperfectly washed, and with the hands in that state he takes up his food at his meals. Thus, day by day, from his own hands, he picks up, with the food he swallows, minute traces of lead, and as lead is what we doctors call a cumulative poison, that is to say, a poison which accumulates in the body, he, in time, becomes charged with sufficient of it to be affected by the diseases which spring from it. This is clear enough as a matter of common sense as well as of common experience. But see the importance of the knowledge rightly applied. It tells us what is as true an experience as the experience above stated, that if lead workers will do two cleanly acts—if they will cover the skin from the solution; or, if they will, before going to their meals thoroughly wash the hands and arms; and pray mind this, if they will follow the simple precaution of taking up all the food that enters the mouth with a fork, never letting the hand touch even the bread or any other food that is eaten, they will save themselves, without any difficulty, from the special perils to which they are now exposed.

Cleanliness of Life.

To all these customs of cleanliness of person and surroundings I must add one more, and that is cleanliness of mind, heart, and conversation. Whatever suggests uncleanliness in these avenues of life, suggests and fosters the worst uncleanliness of physical life. Uncleanliness of this moral kind presents itself in many forms. Man was not made to rest except to rust, and idleness is, therefore, in this list of evils. Passion is on the list, for it leads to disturbance of true physical action, to impurity of blood, of secretion, of tissue. Intemperance is a very curse of uncleanliness, the foulest perhaps of all, and through the moral nature, the most deadly to mind as well as body.

Practical Considerations.

Before I conclude, permit me in a few sentences to direct your minds to the consideration of the great and urgent national advancements for health which it is the duty of all classes of the community, but especially of the industrial classes, since they are the worst sufferers, to enforce on the Government, whatever Government may be in power. These advancements as they stand for legislation affect not one party but all parties; not one section of the nation, but the whole of the nation. They would constitute a charter of health, every section of which is in favour of cleanliness in one or other representation of it. In this charter some of the leading parts might be carried out by local legislation alone and at once; others by general or Parliamentary legislation.

The first advance that the working classes should cry for, in every town, is for a more extended system of public baths and wash-houses. These carry with them the better cleansing of the body itself, and of the articles in which it is clothed. Next to this should come the demand for public laundries, with proper conveniences attached for the disinfection of infected clothing, so that the organic particles of disease by which the great and fatal pestilences are spread should not pass from person to person with the linen and clothing which is called clean, and which is so often sent home falsely named under that disguise. A third matter to urge on authorities is the absolute necessity of giving a pure water supply, a supply disconnected in the most perfect way from the sewage system of the town or the village; a supply that is constant, and requires no cistern in which the pure fluid has to be stored. A fourth improvement to be demanded is for open places in all crowded localities, more space for trees and flowers and grass, with pleasant walks in parks for the people of all ages, and especially for the young, who now fade in the gloom of the streets and alleys and slums of great cities. A fifth necessity to urge for, to insist on, is for better houses for the working populations; houses built on dry and wholesome foundations; houses built of sound and healthy materials; houses constructed with all the modern advantages of drainage, so that each house is absolutely cut off from the sewer; houses that are well arranged for warming and ventilation, and filled with sunlight whenever there is sun; houses placed not miles away from the workshop, and which it is part of a day's labour to reach, to and from the daily labour, but in proximity to the workman's work. A sixth advancement which should be insisted on is the erection of workmen's workrooms in all towns; rooms where no family would be allowed to live, but in which under proper supervision, every working man or working woman ought, for a small sum per week, have a clean and convenient and comfortable workroom, in which he or she could carry out their occupations away from the living room where many are forced often to abide, where the infectious sick are compelled often to lie, and from whence, too often, the particles of disease are carried on the articles of manufacture from the unfortunate home manufactory to the home of the purchaser. A seventh and last demand for improvement which ought to arise from the working classes of all towns, and from none more than from Newcastle, is for the purification of the atmospheric air from smoke and all impure vapours and gases in which plants will not live, and in which man, who was made to breathe in a garden, may live in health. To clear towns like Newcastle of smoke and bad air, to transform them all into gardens, is not a question of science any longer, but of legislation. Science, freed from the shackles of selfishness, apathy, and thoughtlessness, which stand in her way, could make the clearance as easily as she could make a railway tunnel, open a way through a forest, or drain a marsh. It is all a matter for legislation, and it is only for the makers of our laws to say it must be done, and it will be done.

And now, working men and women, I leave these truths with you. Keep them clearly in your minds, treasure them in your hearts; determine resolutely for them, and, lifting up your powerful voices above all the rest, be assured that you can do more to secure the attainment of every point of the charter of health than any power that now exists. Exerting your power, you will become the benefactors of all sections of the community, but it is your own selves that will benefit the most by the effort. It is you who will be raised from poverty to competency, from despondency to happiness, from weakness to power. It is you, above all others, who will exchange the sullied, sombre raiments of disease and early death for the bright and spotless vestments of perfect health and perfected life.

Mr. W. D. Stephens (who had taken the chair in place of Mr. Cowen who had to leave before the conclusion of the lecture) asked the meeting to join with him in giving a most cordial vote of thanks to Dr. Richardson for his very instructive lecture. He was sure they would all agree with him in saying that it was a cause of great thankfulness that the Doctor used the talents God had given him for the purpose of doing good to his fellow-creatures. Many men possessed great talents and powers of thinking, but had not the power of communicating that Dr. Richardson had, and they all recognised in him, besides being the deliverer of the lecture that night, one of the most eloquent and powerful advocates that the temperance cause had ever had in this country. He asked them to show, as a Newcastle audience only could show, their appreciation of the lecture they had heard that night.

Dr. Richardson, in replying, said Napoleon used to say of one of his generals that he was the spoilt child of fortune. He (the lecturer) should soon begin to think himself a spoilt child of fortune, if he met with many such receptions as he had now received. He had been at Newcastle before, he remembered that he then experienced the same kind and friendly greeting, and that led him to hope that, busy as he was, he might some day try to return and court their kindness once again.

REPORT

OF THE

JUDGES OF THE EXHIBITION.

We, the undersigned, the Judges appointed by the Council, beg leave to recommend to the Council the following distribution of Medals and Certificates :—

THE RICHARDSON GOLD MEDAL.

For an Exhibit selected from the Entire Exhibition to be awarded in case of pre-eminent merit only.

We recommend that this Medal, which has not been awarded since the Exhibition at Stafford in 1878, be awarded to :—

Messrs. Mather & Armstrong, *Newcastle-upon-Tyne*, for Siemens's Regenerative Gas Burner.

Silver Medals offered by the Exeter Gas Company.

Four Silver Medals were offered by the Exeter Gas Company for the best Gas Stoves exhibited under the following classes :—

1. For the best Gas Stove or gas apparatus for cooking purposes for families, including a sufficient supply of hot water.
2. For the best Gas Cooking Stove for an artisan's family of from four to eight persons.
3. For the best and most economical Open Gas Fire.
4. For the best heating arrangement for general purposes, among which are included the best method for heating baths.

One has already been awarded at a previous Exhibition for the best heating arrangement for general purposes. The Stoves in competition for the others are all deferred for further practical trials.

MEDALS.

We recommend that Medals should be awarded to the undermentioned Exhibitors :—

Bradford, Thomas, & Co., *London*, for Washing Machines.
British Sanitary Company, *Glasgow*, for Dry Earth Closet.
Hayward, Tyler & Co., *London*, for Full-flush Valveless Closet.

Manlove, Alliott, Fryer & Co., *Nottingham*, for Fryer's Patent Destructor, Fryer's Patent Carbonizer, and Firman's Patent Dessicating and Rendering Apparatus.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Siemens's Patent Regenerative Gas Burner.

Ross, J. A. G., *Newcastle-upon-Tyne*, for Silicate Cotton (Slag-wool).

Societé Française d'Hygiène *Paris*, for their exhibit of Books on Hygiène.

Stott, James, & Co., *Oldham*, for Patent Mercury Gas Governor.

Ward, O. D., *London*, for Household Water Closet.

Wilkinson, W. B. & Co., *Newcastle-upon-Tyne*, for Damp-proof Concrete Pavement.

Wilson Engineering Company, *London*, for improved Wilson Range with Steel Boiler and non-conducting Jacketting.

The Wilson Cooking Range, to which a Medal was awarded at Exeter, is again recommended to receive a medal for notable improvements in its construction. We recommend that with this exception the Exhibits which have already received Medals at previous Exhibitions of the Institute be excluded from awards of Medals, but that some of them should receive Certificates of Merit, and these we have distinguished in the following list by asterisks.

CERTIFICATES OF MERIT.

We further recommend that Certificates of Merit be awarded to the undermentioned Exhibitors :—

Angell, A. T., *London*, for Patent Air-tight Man-hole Door.

Arden, Hill, & Co., *Birmingham*, for Solid Flame Boiling Stove.

Bowden, William, *London*, for Patent Automatic Chariot for Children.

Brady & Martin, *Newcastle-upon-Tyne*, for Central Tube Water Mattress.

Brady & Martin, *Newcastle-upon-Tyne*, for their exhibit of Instruments used by Medical Officers of Health.

Buchan, W. P., *Glasgow*, for Improved Drain-pipe with Access Cover.

Buchan, W. P., *Glasgow*, for Patent Disconnecting Drain-trap.

Capper, Son, & Co., *London*, for Brian Jones's Patent Joint for connecting Closet with Soil-pipe.

*Chorlton & Dugdale, *Manchester*, for "Excelsior" Spring Mattress.

Cregeen, H. S., *Bromley*, for Patent Air Inlet Head for Drain Ventilation.

Craig, J. & M., *Kilmarnock*, for Maguire's Patent Cradle Joint for Drain-pipes.

Craig, J. & M., *Kilmarnock*, for Buchan's Patent Drain-trap and Drain-pipes, with Access Cover.

Craig, J. & M., *Kilmarnock*, for White Enamelled Fire Clay Sinks.

Davis, Joseph & Co., *London*, for New Oven Pyrometer.

Dinning & Cooke, *Newcastle-upon-Tyne*, for Cast Iron Channels for Stable Drainage.

Dinning & Cooke, *Newcastle-upon-Tyne*, for George's Calorigen.

Dinning & Cooke, *Newcastle-upon-Tyne*, for Jennings's Universal Shampooing Apparatus.

Dinning & Cooke, *Newcastle-upon-Tyne*, for their exhibit of Grates, Mantel-pieces, and Over-mantels.

Doulton & Co., *London*, for Anti-percussion High-pressure Bib Valves.

Doulton & Co., *London*, for Bath Locking Valves, for preventing waste of water.

Doulton & Co., *London*, for Latham's Flap Valve.

Doulton & Co., *London*, for Patent Joint for Drain-pipes.

Doulton & Co., *London*, for Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating.

Doulton & Co., *London*, for their Flush-out Closet.

Doulton & Co., *London*, for Tip-up Lavatory Basin.

*Doulton & Co, *London*, for Ventilating Tile Stoves.

Fell, J. & Co., *Wolverhampton*, for Clark's Patent Anti-splash Tip-up Lavatory Basin.

Fell, J. & Co., *Wolverhampton*, for Smith's Patent Cast Lead Syphon Traps.

Fell, J. & Co., *Wolverhampton*, for their exhibit of Water-taps.

Forrest, William, *Newcastle-upon-Tyne*, for the Albo Carbon Light.

Hamilton, William, *Brighton*, for Invalid "Grasshopper" Couch.

Hancock, F. & C., *Dudley*, for Patent Machine for Washing and Peeling Potatoes.

Harriman, W., & Co., *Blaydon-upon-Tyne*, for Fowler's Patent Water-closet.

Hayward, Tyler, & Co., *London*, for Shower and Douche Bracket.

Heron, T., *Manchester*, for Patent Duplex Burner.

Jeyes' Sanitary Compound Company, *London*, for Jeyes' Perfect Purifier.

Kirsop & Co., *Newcastle-upon-Tyne*, for Paragon Washing Machine with Canadian Washer.

Maguire & Son, *Dublin*, for Dr. Scott's Disinfecting Apparatus.

Maling, C. T., *Newcastle-upon-Tyne*, for his exhibit of Sanitary Earthenware.

Maling, C. T., *Newcastle-upon-Tyne*, for Lavatory Basin with Flushing Rim.

Manlove, Alliott, Fryer, & Co., *Nottingham*, for Lyon's Patent Disinfector.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Hink's Patent Duplex Lamp with Extinguisher.

Mather & Armstrong, *Newcastle-upon-Tyne*, for Steam Heating Apparatus, combining heating and ventilating.

Mitchell, James, *Newcastle-upon-Tyne*, for Mitchell's Patent Steam Washer.

Murton, H. A., *Newcastle-upon-Tyne*, for exhibit of Indiarubber Vessels for hospital use.

Nailsworth Foundry Company, *Bristol*, for Morgan's Stench Exhaust.

Rimington Bros. & Co., *Newcastle-upon-Tyne*, for Dean's Gully Trap.

RIMINGTON BROS. & Co., *Newcastle-upon-Tyne*, for Enamelled Fire Clay Bath.

SILICATED CARBON FILTER COMPANY, *London*, for Silicated Carbon Filtering Material.

SMITH, ELDER, & Co., *London*, for their exhibit of Sanitary Publications.

SMITH, JAMES, *Liverpool*, for Open Grate for consuming Smoke.

STRAKER & LOVE, *Newcastle-upon-Tyne*, for their exhibit of large Fire-clay Drain-pipes.

THOMASSON & KEY, *Worcester*, for Cup Grating for Sinks.

THORNBURN, WILLIAM, *Borough Bridge*, for Tubular Calorifer for Greenhouses.

TOWNSEND & Co., *Newcastle-upon-Tyne*, for their exhibit of China Cups and other Vessels for invalid use.

TYLOR, J. & SONS, *London*, for Hospital Slop Sink with Patent Waste-not Regulator Valve.

TYLOR, J. & SONS, *London*, for Bath Locking Valves for preventing waste of water.

TYLOR, J. & SONS, *London*, for Flushing-rim Lavatory Basin with Quick Waste.

TYLOR, J. & SONS, *London*, for Patent Flush-out Urinal Basin.

TYLOR, J. & SONS, *London*, for Patent Joint for Lead Pipes.

TYLOR, J. & SONS, *London*, for Terry's Patent Pedal-action for Water-closets.

TYLOR, J. & SONS, *London*, for Waste-not Regulator Valve.

*WARD, O. D., *London*, for Bean's Direct Acting Valveless Waste Preventer.

WATSON, HENRY & SON, *Newcastle-upon-Tyne*, for the "National" Water-closet.

WATSON, HENRY & SON, *Newcastle-upon-Tyne*, for Waste-preventing Flushing Syphon.

WATSON, HENRY & SON, *Newcastle-upon-Tyne*, for "Crown" Cottage Water-closet.

WHITE, WILLIAM, *Abergavenny*, for Hygeian Rock Building Composition.

*WOOLLAMS & Co., *London*, for Non-arsenical Wall Papers.

WRIGHT & STEVENS, for Syphon Flushing Cistern.

WRIGHT, JOHN & Co., *Birmingham*, for the "Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing.

N.B.—Objects exhibited or invented by any of the Judges themselves are excluded from awards of Medals or Certificates.

EXHIBITS SELECTED FOR FURTHER PRACTICAL TRIAL:

With regard to the following Exhibits, we are unable to give our decisions until we have submitted them to a more complete and extended practical Examination than is possible at the Exhibition:—

Paint and other Protectives.

ALBISSIMA PAINT COMPANY, *London*, Albissima Paint.
SANITARY PAINT COMPANY, *Liverpool*, Sanitary Paints.

Machinery adapted for Sanitary Purposes.

ANDREW, J. E. H. & Co., *Stockport*, Bischop Gas Engine.
TURNER GAS ENGINE COMPANY, *St. Albans*, Gas Engine.

Water Closets.

BUCHAN, W. P., *Glasgow*, Carmichael Wash-down Water-closet.
FELL, J. & Co., *Wolverhampton*, Dodd's "Wash-out" Water-closet.
RIMINGTON BROTHERS & Co., *Newcastle-upon-Tyne*, Bostel's "Excelsior" Closet.

Apparatus for Water Supply.

MAGUIRE & SON, *Dublin*, Flushing Tanks.
DOULTON & Co., *London*, Syphon Flushing Tank.
DOULTON & Co., *London*, Anti-percussion Ball-valve.
DOULTON & Co., *London*, Waste-preventing Closet-valve.
TYLOR, J. & SONS, *London*, Syphon Flushing Tank.
WATSON, HENRY & SON, *Newcastle-upon-Tyne*, Adams's Syphon Flushing Tank.
ROBERTS, CHARLES G., *Haslemere*, Buck's Automatic Rain Water Separator.

Heating Apparatus.

ARDEN, HILL & Co., *Birmingham*, Asbestos Open Gas Fire.
DAVIS, H. & C., *Camberwell Road*, Asbestos Open Gas Fire.
DEFTY, HENRY & Co., *London*, Gas Burner for Economising Consumption of Gas.
DINNING & COOKE, *Newcastle-upon-Tyne*, Dr. Adams's Gas Stove.
PARKER, T. E., *London*, Smoke Consuming Grate.

Cooking Apparatus.

ARDEN, HILL & Co., *Birmingham*, Gas Cooking Stoves.
DAVIS, H. & C., *London*, Gas Cooking Stoves.
WRIGHT, JOHN & Co., *Birmingham*, Gas Cooking Stoves.

Ventilation.

KITE, C. & Co., *London*, Outlet Ventilator.
NORTON VENTILATOR COMPANY, *London*, Norton Ventilating Apparatus.
THOMASSON & KEY, *Worcester*, Inlet Ventilator.

Foods.

Bowden, William, *London*, Indian Teas, Chutney, and Sliced Mangoes.
Edmunds, J., *London*, Currie Powders.
Irvine & Co., *Gateshead*, Mustard.

Filters.

Harrison, J. & H., *Newcastle-upon-Tyne*, Cheavin's Self-Acting Cistern Filter.
Maignen, P. A., *London*, Improved Filtre Rapide.
Mather & Armstrong, *Newcastle-upon-Tyne*, Slack and Brownlow's Patent Compressed Charcoal Filter.

Mineral Waters.

Brady & Martin, *Newcastle-upon-Tyne*, Pitt's Mineral Waters.
British & Foreign Mineral Waters Company, *Glasgow*, Mineral Waters.

Disinfectants.

Antiseptic Apparatus Manufacturing Co., *London*, Red Cross Antiseptic Fluid.
Sanitas Company Limited, *London*, Sanitas Disinfectant.
Sellers, John, *London*, Potash, Coal Tar, and Carbolic Soaps.
Standen, Richard, *Preston*, Disinfecting Powder.

W. H. CORFIELD, *Chairman.*
W. EASSIE.
ROGERS FIELD.
J. WALLACE PEGGS.

APPENDIX.

EXAMINATIONS IN SANITARY SCIENCE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

BOARD OF EXAMINERS.

Chairman.

CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

H. C. BARTLETT, PH.D., F.C.S.
PROF. W. H. CORFIELD, M.A. LOND., M.D. OXON.
PROF. F. S. B. F. DE CHAUMONT, M.D., F.R.S.
ROGERS FIELD, B.A., M.INST. C.E.
W. H. MICHAEL, Q.C., F.C.S.
PROF. H. ROBINSON, M.INST. C.E.
M. OGLE TARBOTTON, M.INST. C.E., F.G.S.
ERNEST TURNER, F.R.I.B.A.

Registrar.

G. J. SYMONS, F.R S.

THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances in connection with the various Acts relating to Public Health, the Sale of Food and Drugs Act, &c., has led the Council of the Sanitary Institute of Great Britain to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency to Local Surveyors and Inspectors of Nuisances.

Visitors duly appointed by the Local Government Board and various bodies connected with the practical application of sanitary science are invited to be present at the Examinations.

The Examinations, which are arranged in two grades, are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their competency in the subjects of Examination. Successful Candidates will be placed on the Register of persons so certificated; this Register will be kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies four hours—viz., from 2 till 4, and from 6 till 8 p.m., and consists of written papers only. Inspectors of Nuisances have two hours' written examination on the first day—viz., from 4 till 6 p.m. On the second day the Examination, for both classes, commences at 11 a.m., and is *vivâ voce*, with one or more questions to be answered in writing, *if deemed necessary*. A Certificate of competency, signed by the examiners, is granted to successful Candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

As Rural Sanitary Authorities are able, under the Public Health Act, 1875, to obtain almost all the powers of Urban Sanitary Authorities, it is not considered advisable to make any distinction in the examination of the two classes of Surveyors.

As one person may, under the Public Health Act, 1875, be both Local Surveyor and Inspector of Nuisances, Candidates wishing to obtain the double qualification may enter for both Examinations on the same occasion.

Candidates are required to furnish to the Board of Examiners satisfactory testimonials as to personal character, and to give two weeks' notice to the Registrar previous to presenting themselves for Examination, stating whether they wish to be examined as Surveyors, as Inspectors of Nuisances, or as both. The fee for Examination must be paid to the Secretary, by Post-Office order or otherwise, at least six days before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

The fees payable for the Examinations are as follows:—

For Surveyors . . . . £5 5s.
For Inspectors of Nuisances . . £2 2s.

Unsuccessful Candidates are allowed to present themselves a second time for one fee.

Examinations during the year 1882 are appointed to be held at the Rooms of the Institute:—

On Thursday and Friday, June 7th and 8th, 1883.
On Thursday and Friday, November 1st and 2nd, 1883.

Forms to be filled up by Candidates previous to Examination will be supplied on application to the Secretary, 9, Conduit Street, W.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

Laws and Bye-Laws—A thorough knowledge of the Acts affecting Sanitary Authorities, as far as they relate to the duties of Local Surveyors; also, of the Model Bye-Laws issued by the Local Government Board.

Sewerage and Drainage—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Sewerage works; the ventilation and flushing of sewers and drains; the internal drainage and other Sanitary arrangements of houses, privies, water-closets, dry-closets, and the removal of refuse; the Sanitary details of Builders' and Plumbers' work.

Water Supply of Towns and Houses—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

Regulation of Cellar Dwellings and Lodging Houses—General principles of Ventilation; the amount of air and space necessary for men and animals; the means of supplying air, and of ensuring its purity.

Highways and Streets—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

All persons who have passed the above Examination and received the Certificate for Local Surveyors are, by virtue of having so passed, entitled to become Members of the Institute for Life, upon payment of Five Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

FOR INSPECTORS OF NUISANCES.

A thorough knowledge of the Provisions of the Acts and Model Bye-Laws relating to the duties of Inspector of Nuisances—also of the working of the Sale of Food and Drugs Act.

A fair knowledgde of the principles of Ventilation, and the simple methods of Ventilating Rooms—Measurement of Cubic Space.

A knowledge of the Physical Characteristics of Good Drinking Water—the various ways in which it may be polluted, and the means of preventing pollution—Methods of Water Supply.

A knowledge of the proper conditions of good drainage.

The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builders' and Plumbers' work.

A knowledge of what constitutes a Nuisance, arising from any Trade, Business, or Manufacture.

A fair knowledge of the characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables), so as to be able to recognise unsoundness.

Some knowledge of Infectious Diseases, and of the Regulations affecting persons suffering or recovering from such diseases.

A knowledge of the best Methods of Disinfection.

Methods of Inspection, not only of Dwellings, Dairies, and Milk-Shops, but of Markets, Slaughter-Houses, Cow-Sheds, and offensive Trades.

Scavenging and the Disposal of Refuse.

All persons who have passed the above Examination and received the Certificate for Inspectors of Nuisances are, by virtue of having so passed, entitled to become Associates of the Institute for Life, upon payment of Three Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

LIST OF BOOKS SUGGESTED BY THE EXAMINERS AS USEFUL TO CANDIDATES.

SURVEYORS.

Laws and Bye-Laws.

The principal Acts affecting Sanitary Authorities, viz:—

Sold by *Eyre & Spottiswoode.*:

- Gas Works Clauses Acts, 1847. *Price* 6*d.*
- Water Works „ „ 1847. *Price* 1*s.*; & 1863, *price* 3*d.*
- Public Health Act, 1875. *Price* 5*s.* 7½*d.*
- „ „ Water, 1878. *Price* 4½*d.*
- Rivers Pollution Act, 1876. *Price* 6*d.*
- Artizans' and Labourers' Dwelling Acts, 1868. *Price* 7½*d.*; and 1875, *price* 1*s.*

Local Government Board. Model Bye-Laws for Sanitary Authorities. *Eyre & Spottiswoode. Price* 4*s.* 6*d.*

†Chambers, George F. Digest of the Law relating to Public Health and Local Government. 7th Edition. *Stevens & Son. Price* £1 8*s.*

†Fitzgerald, Vesey. Public Health Act and Local Government Act, 1875. 3rd Edition. *Waterlow Bros. & Layton. Price* 12*s.* 6*d.*

†Glen, W.C., Q.C. Public Health Act. *Knight. Price* £1 16*s.*

†Lumley. Public Health Act, 1875. *Shaw & Son. Price* £1 5*s.*

†Michael & Will. On Gas and Water. *Butterworth. Price* £1 5*s.*

Stratton's Public Health Acts, 1875. 1880 Edition. *Knight. Price* 3*s.* 6*d.*

†Woolrych. On the Metropolis Local Management Acts. 2nd Edition. *Shaw & Son. Price* £1 1*s.*

Sewerage and Drainage.

Boulnois, H. P., m.inst.c.e. Dirty Dust-Bins and Sloppy Streets. *E. & F. N. Spon. Price* 3*s.* 6*d.*

Buchan, W. Paton. Plumbing. *Crosby, Lockwood & Co. Price* 3*s.* 6*d.*

Denton, J. Bailey, m.inst.c.e. Sanitary Engineering. *E. & F. N. Spon. Price* £1 5*s.*

Field, Rogers, m.inst.c.e. Bye-Laws and Regulations with reference to House Drainage. *E. & F. N. Spon. Price* 1*s.*

Fox, Cornelius B., m.d. Disposal of the Slop Water of Villages. *J. & A. Churchill. Price* 1*s.* 6*d.*

Galton, Douglas, c.b., f.r.s. Observations on the Construction of Healthy Dwellings. *Henry Frowde. Price* 10*s.* 6*d.*

Hellyer, S. S. The Plumber, and Sanitary Houses. 2nd Edition. *B. S. Batsford. Price* 10*s.* 6*d.*

Knight & Co. Annotated Model Bye-Laws of the Local Government Board relating to—I. Cleansing of Privies, &c. II. Nuisances. III. New Buildings. *Knight & Co.* *Price* 8s. 6d.

Latham, Baldwin, m.inst.c.e. Sanitary Engineering. *E. & F. N. Spon.* *Price* £1 10*s*.

Rawlinson, Robt., c.b. Suggestions as to Drainage, Sewerage, and Water Supply. *Knight.* *Price* 3*s*.

†Report of the Committee of The Local Government Board on Treatment of Town Sewage. *Hansard & Co.* *Price, Report* 1*s*.; *Plans* 10*s*.

Russell, J. A. Two Lectures to Builders and Plumbers. *Simpkin, Marshall & Co.*, 1878. *Price* 1*s*. 6*d*.

Water Supply of Towns and Houses.

†Buchan, A. Introductory Text Book of Meteorology. 2nd Edition. *W. Blackwood & Sons.* *Price* 4*s*. 6*d*.

†Humber, William, assoc.m.inst.c.e. Water Supply of Cities and Towns. *Crosby, Lockwood & Co.* *Price* £6. 6*s*.

Parry, Joseph, c.e. Water: its Composition, Collection, and Distribution. *F. Warne.* *Price* 2*s*. 6*d*.

†Sixth Report of the Royal Commissioners on Pollution of Rivers. *Hansard & Co.* *Price* 16*s*.

Regulation of Cellar Dwellings and Lodging Houses, Ventilation, &c.

Galton, Douglas, c.b., f.r.s. Observations on the Construction of Healthy Dwellings. *Henry Frowde.* *Price* 10*s*. 6*d*.

Hartley, W. Noel. Air and its Relation to Life. *Longmans, Green & Co.* *Price* 6*s*.

†Parkes, E. A., m.d., f.r.s., and F. de Chaumont, m.d., f.r.s. A Manual of Practical Hygiene (Chapters on Air). *J. & A. Churchill.* *Price* 18*s*.

Highways and Streets.

Boulnois, H. P., m.inst.c.e. Dirty Dust-Bins and Sloppy Streets. *E. & F. N. Spon.* *Price* 3*s*. 6*d*.

Codrington, T., m.inst.c.e. Maintenance of Macadamised Roads. *E. & F. N. Spon.* *Price* 6*s*.

General.

†Parkes, E. A., m.d., f.r.s., and F. de Chaumont, m.d., f.r.s. A Manual of Practical Hygiene. *J. & A. Churchill.* *Price* 18*s*.

†Wilson, G., m.a., m.d. Handbook of Hygiene and Sanitary Science. *J. & A. Churchill.* *Price* 10*s*. 6*d*.

INSPECTORS OF NUISANCES.

The Principal Acts relating to the Duties of Inspectors, viz:—

Acts	
Public Health Act, 1875. *Price* 5*s*. 7½*d*.	Sold by Eyre & Spottiswoode.
„ „ Water, 1878. *Price* 4½*d*.	
Canal Boats Act, 1877. *Price* 3*d*.	
Sale of Food and Drugs Acts, 1875. *Price* 6*d*.; and 1879, *price* 3*d*.	
Rivers Pollution Act, 1876. *Price* 6*d*.	
Artizans' and Labourers' Dwellings Acts, 1868. *Price* 7½*d*.; and 1875, *price* 1*s*.	
Alkali, &c., Works Regulations Act, 1881. *Price* 5*d*.	
Nuisances Removal Acts, 1855. *Price* 1*s*.; 1860, *price* 3*d*.; and 1866, *price* 1½*d*.	

Local Government Board. Model Bye-Laws for Sanitary Authorities. *Eyre & Spottiswoode. Price* 4*s*. 6*d*

Local Government Board. General Orders relating to Duties of Inspectors of Nuisances, issued March 10th and 13th, 1880.

Metropolitan Board of Works. Bye-Laws under the Slaughter-houses, &c., Act; eight in number.

Metropolitan Board of Works. The Dairies Cowsheds, and Milkshops Order of July, 1879.

STRATTON's Public Health Acts, 1875. 1880 Edition. *Knight. Price* 3*s*. 6*d*.

†WOOLRYCH. On the Metropolis Local Management Acts. 2nd Edition. *Shaw & Son. Price* £1. 1*s*.

BOULNOIS, H. P., M.INST.C.E. Dirty Dust-Bins and Sloppy Streets. *E. & F. N. Spon. Price* 3*s*. 6*d*.

CORFIELD, W. H., M.A., M.D. The Laws of Health. *Longman & Co. Price* 1*s*. 6*d*.

CORFIELD, W. H., M.A., M.D. Dwelling Houses: their Sanitary Construction and Arrangements. *H. K. Lewis. Price* 3*s*. 6*d*.

F. DE CHAUMONT, F.S.B., M.D., F.R.S. Manuals of Health. The Habitation in Relation to Health. *Society for Promoting Christian Knowledge. Price* 1*s*.

FIELD, ROGERS, M.INST.C.E. Bye-Laws and Regulations with Reference to House Drainage. *E. & F. N. Spon. Price* 1*s*.

KNIGHT & CO. Annotated Model Bye-Laws of the Local Government Board relating to—I. Cleansing of Privies, &c. II. Nuisances. III. New Buildings. *Knight & Co. Price* 8s. 6d.

HARTLEY, W. NOEL. Water, Air, and Disinfectants. *Society for Promoting Christian Knowledge. Price* 1*s*.

†PARKES, E. A., M.D., F.R.S., and F. DE CHAUMONT, M.D., F.R.S. A Manual of Practical Hygiene. (Chapters on Water, Air, Food, and Sewage). *J. & A. Churchill. Price* 18*s*.

† *Books marked thus are Works of Reference.*

It is not necessary that Candidates should study all the works mentioned in this List, as two or three are quoted in some subjects to afford greater facilities for obtaining the information.

CANDIDATES WHO HAVE RECEIVED CERTIFICATES AS LOCAL SURVEYORS.

1880, Nov. 5,	Boulnois, H. Percy, m.inst.c.e., Exeter.
1880, Nov. 5,	Burton, W. Kinninmond, Adam Street, Adelphi.
1879, June 4,	Cameron, Donald, Exeter.
1880, June 2,	Clare, Jesse, Sleaford.
1882, Nov. 3,	Cooper, C. H., Wimbledon.
1878, June 5,	Gamble, S. G., a.m.i.c.e., Grantham.
1881, June 3,	Grimley, Samuel S., Ashby-de-la-Zouch.
1878, Nov. 7.	Harger, R., Skipton.
1880, Nov. 5,	Harland, A., a.r.i.b.a., Stanhope Street, N.W.
1882, June 9,	Hubber, Frank, Exeter.
1880, Nov. 5,	Innes, Cosmo, m.inst.c.e., Adam Street, Adelphi.
1878, June 5,	Jenkins, W. J. P., Bodmin.
1880, June 2,	Nichols, H. B., Handsworth.
1877, Oct. 29,	Parker, J., Town Hall, Bridgewater.
1877, Oct. 29,	Robinson, H. W., Ulverston.
1879, June 4,	Touzeau, E. M., Strand, W.C.
1881, June 3,	Whitcombe, A., a.r.i.b.a., John St., Adelphi.
1882, June 9,	Witts, J. W., Market Harborough.

CANDIDATES WHO HAVE RECEIVED CERTIFICATES AS INSPECTOR OF NUISANCES.

1882, June 9,	Abrams, H., Arthur Road, South Hornsey.
1882, June 9,	Atkins, W., Kettering.
1882, June 9,	Baxter, J., Walnut Tree Walk, S.E.
1877, Oct. 29,	Blanchard, Thomas, Evesham.
1879, Nov. 7,	Bolt, Benjamin, Aston, Birmingham.
1877, Oct. 29,	Booker, F., St. Mary's Hall, Coventry.
1882, Nov. 3,	Brown, John, Geneva Terrace, Brixton.
1878, Nov. 7,	Chubb, T. T., Whitchurch.
1880, June 2,	Clare, J., Sleaford.
1879, Nov. 7,	Clarke, A. Lennox, Union Buildings, Selly Oak.
1881, June 3,	Cowderoy, J. T., Wolverhampton.

1878, June 5,	DALE, T. H., Town Hall, Hull.
1878, Nov. 7,	DAVIES, H., Wrexham.
1882, June 9,	FAIRCHILD, S. G., Chesson Road, W., Kensington.
1882, June 9,	FINLAY, A., Town Hall, Scarborough.
1878, Feb. 7,	GANDER, C., Alcester.
1880, Nov. 5,	HARLAND, A., Stanhope Street, N.W.
1878, Nov. 7,	HARRIS, W., Solihull.
1878, June 5,	HAWKES, C., Hackney
1881, Nov. 4,	HORROCKS, J., Chicago.
1879, Nov. 7,	LAPWORTH, J., Bethnal Green.
1882, Nov. 3,	LEGG, J. C., Gayhurst Road, E.
1882, June 9,	LIGHTFOOT, F., Trevor Square, Knightsbridge.
1879, Nov. 7,	OSBORNE, J., Carlisle.
1877, Oct. 29,	PREBBLE, W. S., Blackburn.
1881, June 3,	RAINS, J., Kettering.
1882, Nov. 3,	RICHARDS, DANIEL, Spencer Street, S.W.
1878, Feb. 7,	ROBINSON, J., Farm Street, Berkeley Square.
1881, Nov. 4,	SORTWELL, W., Retreat Place, Hackney.
1882, June 9,	STEERS, G., Wellington Street, Bedford.
1882, Nov. 3,	TAYLOR, ALBERT, Bolton.
1882, Nov. 3,	WATSON, JAMES, Exeter.
1878, Feb. 7,	WATTS, W. F., South Stoneham.
1878, Feb. 7,	WETHERILL, W., Norfolk Street, Batley.
1878, Feb. 7,	WILKINSON, W., Salford.
1881, June 3,	WILKINSON, W., Bury, Lancashire.
1881, Nov. 4,	WITTS, J. W., Market Harborough.
1882, June 9,	WRIGHT, NOAH, Coventry.

EXAMINATION QUESTIONS, 1882.

The following questions were required to be answered in writing. A *vivâ voce* examination took place on the following day.

JUNE 8th, 1882.

SURVEYORS—Paper I. 2 to 4 p.m.

1.—State the principal provisions of the Public Health Act of 1875. Is it applicable to the whole country? Has it been modified by subsequent legislation, and if so, how?

2.—Give the substance of the Model Bye-laws issued by the Local Government Board, regulating the construction and management of slaughter-houses.

3.—A twelve-inch pipe sewer is running half full, and the sewage has a velocity of three feet per second, how many gallons will be discharged per minute? Also, how many gallons per minute will be discharged from a six-inch pipe drain under the same conditions? Give your calculations in full.

4.—Describe and give a sketch of the form of man-hole which you consider best adapted for ordinary town sewers, and state the rule which you adopt for determining the amount of ventilation to be afforded in a main street sewer.

5.—Describe (with diagram) three typical forms of disconnecting traps for drains, and explain their action.

6.—What are the chief points to be looked at in order to determine whether a water-closet is satisfactory, from a sanitary point of view? Illustrate your answer by sketches.

SURVEYORS—Paper II. 6 to 8 p.m.

1.—What is an Artesian well? Under what circumstances would you advise the construction of such a well?

2.—How is drinking water most likely to become polluted—

(*a*) In a town with a public water supply?

(*b*) In a rural district?

What precautions would you take in each case to prevent the pollution?

3.—What circumstances favour the entrance of "ground air" into a building? Why is it necessary to exclude it, and what are the principal modes of doing so?

4.—Give a clear and concise definition of good ventilation, stating how much air is required per head per hour.

5.—Sketch plan and section of a hospital ward and its offices for twelve patients, and state how you would propose to ventilate it.

6.—Sketch sections of roadways constructed of different materials, and state the advantages and disadvantages of each.

INSPECTORS OF NUISANCES—4 to 6 p.m.

1.—What diseases are considered infectious? What is the law with reference to the exposure of persons affected with infectious diseases?

2.—What are the provisions of the Public Health Act of 1875 with regard to cellar dwellings?

3.—Why is ventilation necessary? What is the greatest number of people that should be allowed to sleep in a dormitory 30-ft. by 15-ft. by 12-ft. high?

4.—Under what circumstances is it necessary to have butts or cisterns for the storage of drinking water, of what materials are they usually made, and in what ways may the water in them become contaminated?

5.—What are the relative advantages and disadvantages of pipe and brick drains? What do you consider the least fall that a house drain should have?

6.—What are the most important points to be observed in inspecting a cow-shed?

7.—You are sent for to a house where there is a case of small-pox. What steps would you take?

8.—If you are refused entrance into premises where you have reason to believe that a nuisance exists, what would you do?

NOVEMBER 2nd, 1882.

SURVEYORS—Paper I. 2 to 4 p.m.

1.—What are the chief Sanitary Acts in force?

(*a*) In the Metropolis.

(*b*) In other parts of England.

What are their chief provisions?

2.—What are the principal provisions of the model bye-laws issued by the Local Government Board with reference to—

(*a*) Building construction.

(*b*) House drainage.

(*c*) Ventilation.

3.—What is the primary principle to be observed in the drainage of a town or district, and how would you proceed to determine the size and capacity of the outfall sewer?

4.—What rules should be adhered to in regard to gradients, man-holes, lamp-holes, ventilators, and flushing, in a sewerage system? Illustrate your answer by sketches.

5.—Describe the rules that govern the question of sewage disposal at the outfall.

6.—How far is a separate system of sewerage desirable?

7.—Describe the essential points to be observed in carrying out a system of house drainage. What are the desiderata of a good form of water-closet? Illustrate your answer by sketches.

SURVEYORS—Paper II. 6 to 8 p.m.

1.—What are the first considerations in designing and constructing water-works?

2.—Describe the conditions to be kept in view in selecting a source of water supply.

3.—How much water has been proved by experiment to be used per head in an average household by constant and by intermittent supply? Compare this with the average expenditure of a large town, and explain the cause of the difference, if any.

4.—Describe the best means of casting and testing water pipes, and of making joints.

5.—What amount of cubic space per head is required for healthy sleeping rooms? Why is it necessary to have a certain amount? What limit of height should be allowed to reckon in the calculation?

6.—Describe by a sketch the best transverse section of a paved and of a Macadamised street, each 40 feet wide. How should Macadam be formed and laid?

7.—What is the most economical mode of watering and cleansing streets?

INSPECTORS OF NUISANCES.—4 to 6 p.m.

1.—What are the provisions of the Public Health Act with regard to cellar dwellings?

2.—In inspecting a stream which is complained of as a nuisance, to what points would you direct your attention with the view of making a report?

3.—Give the dimensions of a sleeping room which you would consider suitable for six adults, and state your reasons.

4.—Describe some of the simple forms of ventilating valves in general use, and explain their action.

5.—In what ways may water become polluted after delivery into houses?

6.—What are the objections to brick house-drains? How should house-drains be constructed?

7.—What sanitary defects would you look for in inspecting a house where there has been a case of Diphtheria?

8.—What are the characteristics of various kinds of unsound meat and fish?

EXHIBITIONS OF SANITARY APPARATUS AND APPLIANCES.

The Exhibitions of Sanitary Appliances are held annually in connection with the Autumn Congress, and unpatented exhibits are protected by a certificate granted by the Board of Trade, under the Protection of Inventions Act, 1878.

Judges are appointed by the Council to examine the several exhibits, and award Medals and Certificates of Merit to such objects as they may consider worthy.

In addition to the Ordinary Medals, a special Medal — the Richardson Gold Medal—is offered by the Institute, for a selected exhibit from the entire exhibition, and will be awarded by the Judges in cases of pre-eminent merit only. Selected exhibits of such a nature as to require practical trials which cannot be carried out on the spot, are submitted to such trials upon the Exhibitors defraying the necessary expenses.

The Exhibits are arranged in the following Classes:—

CLASS I.—Construction and Machinery.

- Construction and Materials.
- Paints and other Protectives.
- Wall Papers.
- Decorative Materials.
- Machinery adapted for Sanitary Purposes.
- Washing Machines.

CLASS II.—Sewerage and Water Supply.

- Water Closets.
- Dry Closets.
- Urinals.
- Sewage Treatment.
- Traps.
- Sinks.
- Baths and Lavatories.
- Apparatus for Water Supply.
- Cisterns.
- Flushing and Watering.
- Miscellaneous Sanitary Goods.

CLASS III.—Heating, Lighting, and Ventilation.

- Heating Apparatus.
- Cooking Apparatus.
- Smoke Preventing Appliances.
- Lighting, including Electric Lighting.
- Ventilation.

CLASS IV.—Personal Hygiene, Foods and Disinfectants.

- Clothing.
- Beds, &c.
- Educational Appliances.
- Domestic Appliances.
- Foods.
- Filters, and Arrangements for Softening Water.
- Mineral Waters.
- Disinfectants.
- Disinfecting Apparatus.

CLASS V.—Miscellaneous.

Articles of Sanitary interest not included in the above Classes, such as:—

- Scientific Instruments.
- Books on Sanitation.
- Prevention of Accidents.
- Methods for the Disposal of the Dead, &c., &c., &c.

The following are the Regulations made for the Exhibition at Glasgow, in September, 1883 :—

1.—The Scale of Charge for Floor Space will be 12s. 6d. per foot frontage, with a depth of six feet; Corners and Special Places will be charged at higher rates; Wall Space 6d. to 1s. per square foot. No Floor Space will be allotted for a less sum than £1 5s., or Wall Space for less than 5s. All charges must be paid at the time of Allotment.

2.—Applications for Space must be made on the official form, and under the proper class. They must be sent to Mr. E. L. Box, the Curator of the Exhibition, at the Offices of the Institute, 9, Conduit Street, Regent Street, London, W., not later than Saturday, August 25th, 1883. No application after this date will be received unless accompanied by an extra payment of 5s. per foot frontage.

3.—A full and accurate description of the articles proposed to be shown must be forwarded with each application for space. (*See* No. 12.)

4.—In addition to Articles and Inventions of a strictly technical character, articles of a general character relating to domestic comfort and economy, and life and labour saving apparatus, as well as books, drawings, and photographs, illustrative of the same, may be exhibited.

5.—Exhibits will be received at the Exhibition Building, Glasgow, from Tuesday, September 11th, to Tuesday, September 18th. Exhibits arriving after September 18th will only be admitted on payment of a fine of 5s. per foot frontage; but no exhibit will, under any circumstances, be admitted after Friday, September 21st. No exhibits shall be removed before MONDAY, the 22nd of OCTOBER, and all exhibits must be removed by WEDNESDAY, the 24th OCTOBER, or they will be sold to pay expenses.

6.—The position occupied by each Exhibitor will be determined by the Committee.

7.—Every Article exhibited shall bear a descriptive label, corresponding with the description forwarded with the application (*See* No. 3), and giving also the retail price at which the article can be obtained. The objects exhibited shall be either the actual Articles, Models, or Drawings.

8.—The Exhibition Committee reserve the right to refuse, or order the removal of, any article not deemed suitable.

9.—The Committe will not be responsible for insurance against fire, or in any way for the safety of any articles exhibited. The cost of conveying goods into, placing them in position in, and removing them from, the the Exhibition, including unpacking and packing, must be borne by the Exhibitors.

10.—Under the supervision and control of the Curator, Exhibitors will be permitted to erect benches or other contrivances for displaying their exhibits, and to make connections with the main drain, but will be responsible for the removal of their Exhibits and Fittings at the close of the Exhibition, and must make good, to the satisfaction of the Master of the Works, any damage caused thereby. Gas and Water will be supplied to the Exhibitors, for use in connection with their Exhibits, and charged for.

11.—Exhibitors are permitted to employ persons to explain their exhibits and such persons may receive orders, but are prohibited from soliciting them.

12.—A Catalogue will be published under the authority of the Committee, mainly compiled from the information given by the Exhibitors on their application forms. A few pages in the Catalogue will be reserved for approved Advertisements. For Terms for Advertisements apply to J. MASON, 144, Fleet Street, London, E.C. Advertisements to be forwarded not later than SATURDAY, 8th SEPTEMBER, 1883.

13.—PRIZE MEDALS and CERTIFICATES OF MERIT will be awarded at the discretion of the Judges, and their decisions will in all cases be final. The List of Awards will be published in the Transactions of the Institute for 1883.

14.—It may be impossible for the Judges to come to a satisfactory decision as to the merits of certain exhibits without practical trial, involving special testing and other investigations. In all such cases the following regulations will be adopted:—

(*a*) The Judges have power to take from the Exhibition any specimens they may require for testing.

(*b*) The Judges will select such Exhibits for further practical trial as they may deem desirable. Exhibitors of such selected Exhibits will then be communicated with, and if they desire to submit their Exhibits to a deferred practical trial they will be required to pay such an Entrance Fee as the Committee may determine, for the purpose of defraying the necessary expenses of testing the Exhibits; and also to furnish the Committee with a written or printed statement of the grounds upon which they claim special merit for their Exhibits; and in the case of Patented Inventions, a copy of the Printed Specification of the Patent.

15.—The Richardson Gold Medal *for an* Exhibit Selected from the entire Exhibition *will be awarded by the Judges in case of pre-eminent merit only.*

16.—Silver Medals offered by the Exeter Gas Company.—Three Silver Medals are offered by the Exeter Gas Company for best Gas Stoves exhibited under the following classes:—

1. For the best Gas Stove or Gas Apparatus for cooking purposes for families, including a sufficient supply of hot water.
2. For the best Gas Cooking Stove for an artisan's family of from four to eight persons.
3. For the best and most economical Open Gas Fire.

17.—Protection in accordance with the Protection of Inventions Act, 1870, will be obtained from the Board of Trade for persons desirous of Exhibiting New Inventions.

Table giving particulars with reference to the exhibitions already held.

TABLE A.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.
Number of Exhibitors ...	117	116	189	106	110
„ of Exhibits... ...	294	319	710	500	600
Space occupied (in square ft.)	......	......	......	9725	14520
Number of days Exhibition was open...	14	16	17	19	25
Total number of Visitors ...	......	......	......	8955	8373
Number of Medals awarded .	13	13	12	12	12*
Number of Certificates awarded	None.	27	47	47	70*
Number of Exhibits deferred for further trial... ...	......	7	52	30	37

* These numbers do not include any Medals or Certificates which may be awarded for Exhibits deferred for practical trial.

CLASSIFIED LIST OF MEDALS AWARDED AT THE EXHIBITIONS.

RICHARDSON MEDAL.

NEWCASTLE, 1882. MATHER & ARMSTRONG, *Newcastle-upon-Tyne*, for Siemens's Regenerative Gas Burner.

STAFFORD, 1878. SILICATE PAINT COMPANY, *Cannon Street, E.C.*, for Griffiths' Patent White.

SILVER MEDAL.

Offered by the Exeter Gas Company.

EXETER, 1880. SANITARY & ECONOMIC SUPPLY ASSOCIATION, for Dr. Bond's Euthermic Ventilating Gas Stove.

CLASS I.—CONSTRUCTION AND MACHINERY.

(1). Construction and Materials.

NEWCASTLE, 1882. WILKINSON, W. B., *Newcastle-upon-Tyne*, for Damp-proof Concrete Pavement.

CROYDON, 1879. WILLCOCKS & CO., *Burmantofts, Leeds*, for Silica Glazed and Enamelled Fire Clay Bricks and Fäience.

(2). Paints and other Protectives.

STAFFORD, 1878. SILICATE PAINT COMPANY, *Cannon Street, E.C.*, for Griffiths' Patent White, and for their preparations of Silicate Paint, Enamel Paint, and Petrifying Liquid.

(3). Wall Papers.

CROYDON, 1879. WOOLAMS & CO., *High Street, Marylebone*, for Paper Hangings free from Arsenic.

(4). Decorative Materials.

EXETER, 1880. WEBB, H. CHALK, *Worcester*, for Colouring Patterns through the Substance of Wood.

(5.) Machinery adapted for Sanitary Purposes.

CROYDON, 1879. AVELING & PORTER, *Rochester*, for Improved Six-Ton Steam Road Roller.

Newcastle, 1882. Manlove, Alliott, Fryer & Co., *Nottingham*, for Fryer's Patent Destructor, Fryer's Patent Carbonizer, and Firman's Patent Dessicating and Rendering Apparatus.

(6). Washing Machines.

Leamington, 1877. Borwell, J., *Britannia Foundry*, *Burton-on-Trent*, for Improved Washer, with table complete.

Leamington, 1877. Bradford, T. & Co., *High Holborn*, *W.C.*, for New Patent "Shuttle" Steam Power Washing Machine.

Newcastle, 1882. Bradford, Thomas, & Co., *London*, for Washing Machines.

CLASS II.—SEWERAGE AND WATER SUPPLY.

(1). Water Closets.

Leamington, 1877. Bostel, D. T., *Duke Street*, *Brighton*, for Excelsior Water Closet.

Newcastle, 1882. Hayward, Tyler & Co., *London*, for Full-flush Valveless Closet.

Newcastle, 1882. Ward, O. D., *London*, for Household Water Closet.

(2). Dry Closets.

Newcastle, 1882. British Sanitary Company, *Glasgow*. for Dry Earth Closets.

Leamington, 1877. Haresceugh, B. B. & Co., *Bentinck Street*, *Leeds*, for Excreta Pail (oak) with Spring Lid.

Exeter, 1880. Moser, L., *Southampton*, for Dry Closet, suitable for Ashes or Disinfecting Powder.

Stafford, 1878. Moule's Patent Earth Closet Company, 5*a*, *Garrick Street*, *W.C.*, for their Earth Closets.

Leamington, 1877. Parker, J., *Woodstock*, *Oxford*, for Dry Earth Closet.

Stafford, 1878. Sanitary Appliance Company, *Salford*, for Sifting Ash Closet, with Soil Pail.

(3). Urinals.

(4). Sewage Treatment.

(5). Traps.

(6). Sinks.

No awards.

(7). Baths and Lavatories.

Leamington, 1877. Galbraith, T., *Crawford Square*, *Londonderry* for Hot-Air Bath.

CROYDON, 1879. LASCELLES, W., *Bunhill Row, E.C.*, for Concrete Bath in one piece.

EXETER, 1880. TYLOR & SONS, *Newgate Street, E.C.*, for Flushing Rim Lavatory Basin and Apparatus.

(8). Apparatus for Water Supply.

CROYDON, 1879. DOULTON & Co., *Lambeth, London*, for Anti-Percussion High Pressure Valves.

LEAMINGTON, 1877. LE GRAND & SUTCLIFFE, *Bunhill Row, E.C.*, for Improvements in Well Sinking Apparatus.

(9). Cisterns.

(10). Flushing and Watering.

No awards.

(11). Miscellaneous Sanitary Goods.

EXETER, 1880. BEAN, A. T., 5, *Cannon Row, S.W.*, for Direct Acting Valveless Waste Preventer.

STAFFORD, 1878. DOULTON & Co., *Lambeth, London*, for Stanford's Patent Joints for Stoneware Pipes.

CLASS III.—HEATING, LIGHTING, AND VENTILATION.

(1). Heating Apparatus.

EXETER, 1880. DOULTON & Co., *Lambeth, London*, for Ventilating Tile Stove.

NEWCASTLE, 1882. ROSS, J. A. G., *Newcastle-upon-Tyne*, for Silicate Cotton (Slag-wool).

EXETER, 1880. SANITARY & ECONOMIC SUPPLY ASSOCIATION, *Gloucester*, for Dr. Bond's Euthermic Gas Stove.

(2). Cooking Apparatus.

STAFFORD, 1878. BILLING & Co., *Hatton Garden, E.C.*, for Apparatus for Cooking by Gas.

LEAMINGTON, 1877. HARRIS, G. H., *Bristol Street, Birmingham*, for Economical Cooking Range.

STAFFORD, 1878. HASSALL & SINGLETON, *Birmingham*, for Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas.

STAFFORD, 1878. LEONI, S. & Co., *Strand*, for Apparatus for Cooking by Gas.

CROYDON, 1879. WENHAM, W. P., *Church Street, Croydon*, for an Improved Open or Close Range Kitchener.

EXETER, 1880. WILSON ENGINEERING COMPANY, *Holborn, W.C.*, for Wilson Portable Close Cooking Range.

NEWCASTLE, 1882. WILSON ENGINEERING COMPANY, *London*, for improved Wilson Range with Steel Boiler and non-conducting Jacketting.

(3). Lighting.

CROYDON, 1879. HAMILTON & Co., *Leadenhall Street, E.C.*, for Patent Prismoidal Pavement and Floor Lights

NEWCASTLE, 1882. MATHER & ARMSTRONG, *Newcastle-upon-Tyne*, for Siemen's Patent Regenerative Gas Burner.

NEWCASTLE, 1882. STOTT, JAMES, & Co., *Oldham*, for Patent Mercury Gas Governor.

(4). Ventilation.

STAFFORD, 1878. ELLISON, J. E., *Leeds*, for Conical Ventilators.

EXETER, 1880. HUNT, NATHAN, *Bristol*, for Auto-Pneumatic Ventilation.

EXETER, 1880. MOORE, J., *St. James' Walk, Clerkenwell, E.C.*, for Glass Louvre Ventilators.

STAFFORD, 1878. PRITCHETT, G. E., 20, *Spring Gardens, S.W.*, for Economic Hollow Flooring.

CLASS IV. — PERSONAL HYGIENE FOODS, AND DISINFECTANTS.

(1). Clothing.

No awards.

(2). Beds, &c.

LEAMINGTON, 1877. CHORLTON & DUGDALE, *Manchester*, for Excelsior Spring Mattress.

STAFFORD, 1878. POCOCK BROS., *Southwark Bridge Road*, for Universal Invalid Tubular Water and Air Bed.

(3). Educational Appliances.

EXETER, 1880. COLMAN & GLENDENNING, *Norwich*, for School Furniture.

(4). Domestic Appliances.

EXETER, 1880. CARTER, J., 6*a*, *Cavendish Street, W.*, for Invalid Furniture.

LEAMINGTON, 1877. HANCOCK, F. & C., *Dudley, Worcester*, for Machine for Washing and Cooling Butter.

CROYDON, 1879. READ, JEFFERSON, *Birmingham*, for Arcanum Process of Silver Plating Steel.

(5). Foods.

No awards.

(6). Filters and Arrangements for Softening Water.

CROYDON, 1879. MAIGNEN, P. A., *Great Tower Street, E.C.*, for Filtre Rapide.

LEAMINGTON, 1877. SPONGY IRON WATER PURIFYING COMPANY, *Oxford Street, W.C.*, for Bischof's Spongy Iron Filter.

(7). Mineral Waters.

No awards.

(8). Disinfectants.

LEAMINGTON, 1877. CALVERT & Co,, *Bradford, Manchester*, for Calvert's Carbolic Acid for disinfecting purposes.

STAFFORD, 1878. MORRIS, LITTLE & Co., *Doncaster*, for Little's Soluble Phenyle.

LEAMINGTON, 1877. SOCIÉTÉ FRANÇAISE D'HYGIÈNE, *Paris*, for Chemical Preparations and Apparatus.

(9). Disinfecting Apparatus.

CROYDON, 1879. FRASER BROS., *Commercial Road, E.*, for Portable Disinfecting Apparatus.

CROYDON, 1879. WALKER, CHAS. W., *Wandsworth Common*, for Acid Pump and Syphon.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary Interest not included in the above Classes, such as :—

(1). Scientific Instruments.

No awards.

(2). Books on Sanitation.

NEWCASTLE, 1882. SOÇIETÉ D'HYGIÈNE, *Paris*, for their exhibit of Books on Hygiène.

(3). Prevention of Accidents.

(4). Methods for the Disposal of the Dead.

No awards.

(5.) Sundries.

STAFFORD, 1878. DUNCAN, Maj. F., *The Common, Woolwich*, for Ambulance Wheeled Litter.

CROYDON, 1879. SINCLAIR, J., *Leadenhall Street, E.C.*, for Tyndall's Smoke Respirator.

CERTIFICATES AWARDED AT THE EXHIBITIONS.

* Medal Awarded at a Previous Exhibition.

CLASS I.—CONSTRUCTION AND MACHINERY.

(1). Construction and Materials.

CROYDON, 1879. ADAMS, R., 7, *Great Dover Street, S.E.*, for Adjustable Shoe, and Regulating Spring Hinge for Swinging Doors.

CROYDON. 1879. ADAMS, R., 7, *Great Dover Street, S.E.*, for Fanlight Openers and Casement Fasteners.

EXETER, 1880. CANDY & Co., *Newton Abbot*, for Granite Vitrified Bricks and Paving.

CROYDON, 1879. *PRITCHETT, G. E., F.S.A., 20, *Spring Gardens, S.W.*, for Improvements in Hollow Tile Flooring.

EXETER, 1880. *SALMON, BARNES & Co., *Ulverston*, for Revolving Shutters with Patent Balance Weight Motion.

NEWCASTLE, 1882. WHITE, WILLIAM, *Abergavenny*, for Hygeian Rock Building Composition.

(2). Paints and other Protectives.

No award.

(3). Wall Papers.

NEWCASTLE, 1882. *WOOLLAMS & Co., *London*, for Non-arsenical Wall Papers.

(4). Decorative Materials.

CROYDON, 1879. DOULTON & Co., *Lambeth, London*, for Decorative Tiles for Covering Walls and Floors.

(5). Machinery adapted for Sanitary Purposes.

EXETER, 1880. MCCALLUM, J. B., *Stafford*, for Improved Non-Absorbent Tub or Pail Van.

(6). Washing Machines.

STAFFORD, 1878. *BRADFORD, THOMAS, & Co., *Salford*, for Shuttle Steam-Power Washing Machine.

EXETER, 1880. GARTON & KING, *Exeter*, for Vowel E. Bradford's Family Washing Machine.

NEWCASTLE, 1882. KIRSOP & Co., *Newcastle-upon-Tyne*, for Paragon Washing Machine with Canadian Washer.

NEWCASTLE, 1882. MITCHELL, JAMES, *Newcastle-upon-Tyne*, for Mitchell's Patent Steam Washer.

CLASS II.—SEWERAGE AND WATER SUPPLY.

(1). Water Closets.

CROYDON, 1879. BEARD, DENT & HELLYER, 21, *Newcastle Street, W.C.*, for Artizan Closet.

STAFFORD, 1878. *BOSTEL, D. T., *Duke Street, Brighton*, for "Excelsior" Water Closet.

EXETER, 1880. DOULTON & Co., *Lambeth, London*, for an Economical Flush-Out Closet.

NEWCASTLE, 1882. DOULTON & Co., *London*, for their Flush-out Closet.

NEWCASTLE, 1882. HARRIMAN, W. & Co., *Blaydon-upon-Tyne*, for Fowler's Patent Water-closet.

EXETER, 1880. TYLOR, J., & SONS, 2, *Newgate Street, E.C.*, for "Clear Way" Regulator Valve Water Closet, without overflow communicating with Valve Box.

NEWCASTLE, 1882. WATSON, HENRY & SON, *Newcastle-upon-Tyne*, for the "National" Water-closet.

NEWCASTLE, 1882. WATSON, HENRY, & SON, *Newcastle-upon-Tyne*, for "Crown" Cottage Water-closet.

(2). Dry Closets.

EXETER, 1880. BRITISH SANITARY COMPANY, *Glasgow*, for Self-Acting Earth Closet.

STAFFORD, 1878. *HARESCEUGH, B. B. & Co., *Leeds*, for Excreta Pail (oak) with Patent Spring Lid.

CROYDON, 1879. *MOULE'S PATENT EARTH CLOSET COMPANY (LIMITED), 5*a*, *Garrick Street, W.C.*, for Earth Closet.

CROYDON, 1879. ONIONS, J. C., (LIMITED), *Birmingham*, for Moser's Patent Self-Acting Dry Closet.

EXETER, 1880. PARKER, J., *Woodstock*, for Dry Earth Commode without Separator.

CROYDON, 1879. *SANITARY APPLIANCE COMPANY, *Factory Lane, Salford*, for Patent Cinder-Sifting Ash Closet.

EXETER, 1880. *WIPPELL BROS. & ROW, 231 and 232, *High Street, Exeter*, for Moule's Earth Closet.

(3). Urinals.

NEWCASTLE, 1882. TYLOR, J. & SONS, *London*, for Patent Flush-out Urinal Basin.

(4). Sewage Treatment.

STAFFORD, 1878. SHONE, ISAAC, *Wrexham*, for Pneumatic Liquid Ejector.

(5). Traps.

CROYDON, 1879. BEARD, DENT & HELLYER, 21, *Newcastle Street, W.C.*, for Patent Ventilating Drain Syphon.

NEWCASTLE, 1882. BUCHAN, W. P., *Glasgow*, for Patent Disconnecting Drain-trap.

Exeter, 1880. Craig, J. & M., *Kilmarnock*, for Buchan's Patent Trap.

Newcastle, 1882. Craig, J. & M., *Kilmarnock*, for Buchan's Patent Drain-trap and Drain-pipes, with Access Cover.

Croydon, 1879. Doulton & Co., *Lambeth*, *London*, for Disconnecting Gully, with back and side Entrances and iron grating.

Newcastle, 1882. Doulton & Co., *London*, for Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating.

Croydon, 1879. Edwards, J. C., *Trefynant Ruabon*, for Dean's Patent External Drain Traps, with movable receptacle.

Newcastle, 1882. Fell, J. & Co., *Wolverhampton*, for Smith's Patent Cast Lead Syphon Traps.

Croydon, 1879. Hammond & Hussey, *High Street*, *Croydon*, for Hornibrook's Patent Catchment Grating for Steep Gradients.

Croydon, 1879. Hygienic Stove and Grate Company, 15, *Peel Buildings*, *Birmingham*, for "Eagle" Sanitary Trap, for superseding Bell Traps.

Stafford, 1878. Potts & Co., *Handsworth*, *Birmingham*, for the Edinburgh Air-Chambered Sewer Trap.

Newcastle, 1882. Rimington Bros. & Co., *Newcastle-upon-Tyne*, for Dean's Gully Trap.

Stafford, 1878. Stiff, James, & Sons, *Lambeth*, *London*, for Weaver's Ventilating Sewer Air Trap.

(6). Sinks.

Newcastle, 1882. Craig, J. & M., *Kilmarnock*, for White Enamel-Fire Clay Sinks.

Croydon, 1879. Jennings, G., *Stangate*, *London*, for "Artizans' Dwellings Sink."

Croydon, 1879. Stidder & Co., 50, *Southwark Bridge Road*, *S E.*, for Swivel, Lock Plug, and Overflow for Sinks.

Exeter, 1880. Tylor, J. & Sons, 2, *Newgate Street*, *E.C.*, for Improved Enamelled Iron Slop Sink, with Patent Regulator Supply Valve.

Newcastle, 1882. Tylor, J. & Sons, *London*, for Hospital Slop Sink with Patent Waste-not Regulator Valve.

Croydon, 1879. Willcock & Co., *Burmantofts*, *Leeds*, for Fire-Clay Sanitary Sinks, and Water Troughs.

(7). Baths and Lavatories.

Newcastle, 1882. Dinning & Cooke, *Newcastle-upon-Tyne*, for Jennings's Universal Shampooing Apparatus.

Newcastle, 1882. Doulton & Co., *London*, for Tip-up Lavatory Basin.

NEWCASTLE, 1882.	FELL, J. & Co., *Wolverhampton*, for Clark's Patent Anti-splash Tip-up Lavatory Basin.
STAFFORD, 1878.	GILLOW & Co., *Oxford Street*, *W.*, for Lavatory.
NEWCASTLE, 1882.	HAYWARD, TYLER & Co., *London*, for Shower and Douche Bracket.
CROYDON, 1879.	JENNINGS, G., *Stangate*, *London*, for "Universal" Shampooing Apparatus.
EXETER, 1880.	*LASCELLES, W., 121, *Bunhill Row*, *London*, for Concrete Bath, in one piece.
NEWCASTLE, 1882.	MALING, C. T., *Newcastle-upon-Tyne*, for Lavatory Basin with Flushing Rim.
NEWCASTLE, 1882.	MALING, C. T., *Newcastle-upon-Tyne*, for his exhibit of Sanitary Earthenware.
NEWCASTLE, 1882.	RIMINGTON BROS., & Co., *Newcastle-upon-Tyue*, For Enamelled Fire Clay Bath.
STAFFORD, 1878.	RUFFARD & Co., *Clay Works*, *Stourbridge*, for Porcelain Baths, moulded and glazed in one piece.
NEWCASTLE, 1882.	TYLOR, J. & SONS, *London*, for Flushing-rim Lavatory Basin with Quick Waste.

(8). Apparatus for Water Supply.

CROYDON, 1879.	BRAITHWAITE & Co., *Leeds*, for Patent Syphon for Water Closet Cisterns.
EXETER, 1880.	*DOULTON & Co., *Lambeth*, *London*, for Anti-percussion High Pressure Draw-off Valves.
NEWCASTLE, 1882.	DOULTON & Co., *London*, for Anti-percussion High-pressure Bib Valves.
NEWCASTLE, 1882.	DOULTON & Co., *London*, for Bath Locking Valves, for preventing waste of water.
NEWCASTLE, 1882.	DOULTON & Co., *London*, for Latham's Flap Valve.
NEWCASTLE, 1882.	FELL, J. & Co., *Wolverhampton*, for their exhibit of Water-taps.
CROYDON, 1879.	FINCH & Co., 181, *High Holborn*, *W.C.*, for large Way Waste Plug, with Protective Cover.
CROYDON, 1879.	HEADLEY & SONS, *Cambridge*, for Patent Hose Reel.
CROYDON, 1879.	*LE GRAND & SUTCLIFFE, 100, *Bunhill Row*, *London*, for Improvements in Internal driving of Tube Wells.
EXETER, 1880.	TYLOR, J. & SONS, 2, *Newgate Street*, *E.C.*, for Improved Full-Way Stop Valve.
EXETER, 1880.	TYLOR, J. & SONS, 2, *Newgate Street*, *E.C.*, for "Waste Not" Regulator Valve.
NEWCASTLE, 1882.	TYLOR, J. & SONS, *London*, for Bath Locking Valves for preventing Waste of Water.
NEWCASTLE, 1882.	TYLOR, J. & SONS, *London*, for Waste-not Regulator Valve.

(9). Cisterns.

No awards.

(10). Flushing and Watering.

Newcastle, 1882.	Watson, Henry & Son, *Newcastle-upon-Tyne*, for Waste-preventing Flushing Syphon.
Newcastle, 1882.	Wright & Stevens, for Syphon Flushing Cistern.

(11). Miscellaneous Sanitary Goods.

Newcastle, 1882.	Angell, A. T., *London*, for Patent Air-tight Man-hole Door.
Exeter, 1880.	Branksea Island Pottery Company (Limited), *Poole, Dorset*, for Stoneware Pipes
Newcastle, 1882.	Buchan, W. P., *Glasgow*, for improved Drain-pipe with Access Cover.
Newcastle, 1882.	Capper, Son, & Co., *London*, for Brian Jone's Patent Joint for connecting Closet with Soil-pipe.
Newcastle, 1882.	Craig, J. & M., *Kilmarnock*, for Maguire's Patent Cradle Joint for Drain-pipes.
Newcastle, 1882.	Dinning & Cooke, *Newcastle-upon-Tyne*, for Cast Iron Channels for Stable Drainage.
Exeter, 1880.	*Doulton & Co., *Lambeth, London*, for Stanford's Patent Joints for Stoneware Pipes.
Newcastle, 1882.	Doulton & Co., *London*, for Patent Joint for Drain-pipes.
Stafford, 1878.	Oates & Green, *Horley Green Fire Clay Works, Halifax*, for Patent Drain-cleaning Rods and Stoneware Horse Manger.
Croydon, 1879.	Patent Victoria Stone Company, *Kingsland Road, E.*, for Artificial Stone Tubes.
Croydon, 1879.	Sharp, Jones & Co., *Bourne Valley Pottery, Poole, Dorset*, for Rock Concrete Tubes.
Newcastle, 1882.	Straker & Love, *Newcastle-upon-Tyne*, for their Exhibit of large Fire-clay Drain-pipes.
Newcastle, 1882.	Thomasson & Key, *Worcester*, for Cup Grating for Sinks.
Newcastle, 1882.	Tylor, J. & Sons, *London*, for Patent Joint for Lead Pipes.
Newcastle, 1882.	Tylor, J. & Sons, *London*, for Terry's Patent Pedal-action for Water-closets.
Newcastle, 1882.	*Ward, O. D., *London*, for Bean's Direct Acting Valveless Waste Preventer.
Exeter, 1880.	Wippell Bros. & Row, 231, *High Street, Exeter*, for Ransome's Artificial Stone Air Brick.

CLASS III.—HEATING, LIGHTING AND VENTILATION.

(1). Heating Apparatus.

Newcastle, 1882.	Dinning & Cooke, *Newcastle-upon-Tyne*, for George's Calorigen.

NEWCASTLE, 1882. DINNING & COOKE, *Newcastle-upon-Tyne*, for their exhibit of Grates, Mantel-pieces, and Over-mantels.

NEWCASTLE, 1882. *DOULTON & Co., *London*, for Ventilating Tile Stoves.

NEWCASTLE, 1882. MATHER & ARMSTRONG, *Newcastle-upon-Tyne*, for Steam Heating Apparatus, combining heating and ventilating.

STAFFORD, 1878. PRITCHETT, G. E., 20, *Spring Gardens, S.W.*, for Warming and Ventilating Appliances.

EXETER, 1880. PRITCHETT, G. E., 20, *Spring Gardens, S.W.*, for Corrugated Iron Hot-Water Warming Appliances.

NEWCASTLE, 1882. SMITH, JAMES, *Liverpool*, for Open Grate for consuming Smoke.

STAFFORD, 1878. SNELL, H. SAXON, *Southampton Buildings*, for the Thermhydric Ventilating Hot-water Open Fire Grate.

NEWCASTLE, 1882. THORNBURN WILLIAM, *Borough Bridge*, for Tubu-Calorifer for Greenhouses.

EXETER, 1880. WIPPELL BROS. & ROW, *Exeter*, for Conservatory Boiler, with Hot-Water Pipe.

NEWCASTLE, 1882. WRIGHT, JOHN & Co., *Birmingham*, for the "Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing.

(2). Cooking Apparatus.

NEWCASTLE, 1882. ARDEN, HILL, & Co., *Birmingham*, for Solid Flame Boiling Stove.

CROYDON, 1879. *BILLING & Co., *Hatton Garden, E.C.*, for the "Workman's" Cooking Stove, and other Improvements in Gas-Cooking Stoves.

EXETER, 1880. CHORLTON & DUGDALE, 19, *Blackfriars Street, Manchester*, for "Sunlight Stove."

EXETER, 1880. CONSTANTINE, T. J., *Fleet Street, E.C.*, for the Devonshire Cooking Range.

STAFFORD, 1878. *HARRIS, G. H., *Bristol Street, Birmingham*, for Economical Cooking Range.

CROYDON, 1879. LEWIS, MRS. A., *Manchester*, for Tin Cooking Utensils.

CROYDON, 1879. WALLER, THOS., 47, *Fish Street Hill, E.C.*, for Cooking Stove with Warm-Air Chamber,

EXETER, 1880. WIPPELL BROS. & ROW, 231 and 232, *High Street, Exeter*, for Cottage Range.

(3). Lighting.

CROYDON, 1879. BRAY & Co., *Blackman Lane, Leeds*, for Improved Gas Burners.

CROYDON, 1879. CLARKE, F. W., PORTABLE GAS APPARATUS COMPANY (LIMITED), *Great Queen Street, W.C.*, for Patent Portable Gas Apparatus for Manufacturing Gas from Gasoline.

NEWCASTLE, 1882. FORREST, WILLIAM, *Newcastle-upon-Tyne*, for the Albo Carbon Light.

NEWCASTLE, 1882. HERON, T., *Manchester*, for Patent Duplex Burner.

STAFFORD, 1878. LEONI, S. & Co., *Strand, W.C.*, for the "Rheometer" Street Lamp Regulator.

NEWCASTLE, 1882. MATHER & ARMSTRONG, *Newcastle-upon-Tyne*, for Hink's Patent Duplex Lamp with Extinguisher.

CROYDON, 1879. RANSOME, S. E., & Co., 10, *Essex Street, W.C.*, for "Milwaukee" Glass Lantern or Hurricane Lantern.

EXETER, 1880. WILLEY & Co., *Exeter*, for their Exhibit of Gaseliers and Gas Brackets.

EXETER, 1880. WIPPELL BROS. & ROW, 231, *High Street, Exeter*, for Chappuis Daylight Reflector.

(4). Ventilation.

CROYDON, 1879. BIRD, PETER HINCKES, 1, *Norfolk Square, W.*, for his Method of Costless Ventilation.

NEWCASTLE, 1882. CREGEEN, H. S., *Bromley*, for Patent Air Inlet Head for Drain Ventilation.

CROYDON, 1879. *ELLISON, J. E., *Victoria Square, Leeds*, for Conical Ventilators.

CROYDON, 1879. KNELL, U., 77, *Fore Street, E.C.*, for "Imperial" Ventilating Window.

NEWCASTLE, 1882. NAILSWORTH FOUNDRY COMPANY, *Bristol*, for Morgan's Stench Exhaust.

EXETER, 1880. SHARP, C. H. & Co., *High Holborn, E.C.*, for Ornamental Inlet Ventilators.

CROYDON, 1879. WENHAM & Co., *Church Street, Croydon*, for Boyle's Mica-Valved Outlet Ventilator.

CLASS IV.—PERSONAL HYGIENE, FOODS, AND DISINFECTANTS.

(1.) Clothing.

STAFFORD, 1878. BARTRUM, HARVEY & Co., *London*, for Patent Ventilatorium Waterproof Garments.

(2). Beds, &c.

STAFFORD, 1878. ALLEN, THOMAS, *St. Augustine's Parade, Bristol*, for Metallic Tubular Bedsteads and Invalid Bedrests.

Croydon, 1879. Ball, Ancell, *Spalding*, for Folding Invalid Bed.

Newcastle, 1882. Brady & Martin, *Newcastle-upon-Tyne*, for Central Tube Water Mattress.

Exeter, 1880. Brock, William & Co., 177, *Fore Street, Exeter*, for Bed Rest with Movable Arms.

Exeter, 1880. Brock, William, & Co., 177, *Fore Street, Exeter*, for "Nonsuch" Adjustable Chair.

Croydon, 1879. Bussey & Co., *Museum Works, Peckham, S.E.*, for Patent Spring Mattress.

Stafford, 1878. *Chorlton & Dugdale, *Manchester*, for "Excelsior" Spring Mattress.

Croydon, 1879. *Chorlton & Dugdale, *Manchester*, for "Excelsior" Spring Mattress Hospital Bed.

Exeter, 1880. Chorlton & Dugdale, *Manchester*, for "Invalid?'" Adjustable Bed.

Exeter, 1880. *Chorlton & Dugdale, *Manchester*, for "Excel-Spring" Mattress.

Newcastle, 1882. *Chorlton & Dugdale, *Manchester*, for "Excelsoir" Spring Mattresss.

Exeter, 1880. Colman & Glendenning, *Norwich*, for Patent Automaton Seat for Drapers.

Stafford, 1878. Hamilton, W., *Brighton*, for Invalid "Grasshopper" Couch.

Newcastle, 1882. Hamilton, William, *Brighton*, for Invalid "Grasshopper" Couch.

Croydon, 1879. *Pocock Bros., *Southwark Bridge Road, S.E.*, for "Universal" Tubular Air and Water Bed.

Exeter, 1880. Wippell Bros. & Row, *Exeter*, for Fernby's "Paragon" Camp Furniture.

(3). Educational Appliances.

Stafford, 1878. Colman & Glendenning, *Norwich*, for School Desks with Shifting Seats.

Stafford, 1878. Larmouth, Thomas, & Co., *Salford*, for Dual Desk, with Separate Gangway Seat.

(4). Domestic Appliances.

Newcastle, 1882. Bowden, William, *London*, for Patent Automatic Chariot for Children.

Stafford, 1878. Compostella Fire Light Company, *Fenchurch Street, E.C.*, for the Compostella Fire Lights for Lighting Fires.

Stafford, 1878. *Hancock, F. & C., *Dudley, Worcester*, for Machine for Washing and Cooling Butter.

Exeter, 1880. Hancock, F. & C., *Dudley, Worcester*, for Dough Kneading Machine.

Exeter, 1880. Hancock, F. & C., *Dudley, Worcester*, for New Propellor Churn.

NEWCASTLE, 1882. HANCOCK, F. & C., *Dudley*, for Patent Machine for Washing and Peeling Potatoes.

STAFFORD, 1878. HILTON, W. H., *Leamington*, for Various Inventions for Promoting Domestic Economy.

EXETER, 1880. HUTCHINSON, A. & Co., *Great Winchester Street, E.C.*, for India Rubber Gas Tubing.

NEWCASTLE, 1882. MURTON, H. A., *Newcastle-upon-Tyne*, for exhibit of Indiarubber Vessels for hospital use.

NEWCASTLE, 1882. TOWNSEND & Co., *Newcastle-upon-Tyne*, for their Exhibit of China Cups and other Vessels for invalid use.

EXETER, 1880. WIPPELL BROS. & ROW, *High Street, Exeter*, for Improved Housemaid's Box with Sifter.

(5). Foods.

EXETER, 1880. FRY, J. S., & SONS, *Union Street, Bristol*, for Cocoa Extract and Preparations of Chocolate.

(6). Filters and Arrangements for Softening Water.

EXETER, 1880. MAIGNEN, P. A., 20 & 23, *Great Tower Street, E.C.*, for "Bijou" Filtre Rapide.

EXETER, 1880. *MAIGNEN, P. A., 20 & 23, *Great Tower Street, E.C.*, for Filtre Rapide.

EXETER, 1880. SILICATED CARBON FILTER COMPANY, *Battersea*, for Silicated Carbon Double Chambered Table Filters.

NEWCASTLE, 1882. SILICATED CARBON FILTER COMPANY, *London*, for Silicated Carbon Filtering Material.

EXETER, 1880. STEPHAN, J. A., *Worcester*, for Carbonised Iron Stone Mound Filter for Water.

STAFFORD, 1878. THORN & Co., *Stafford*, for Artificial Stone Filters, for Cleansing Rain Water for Domestic Use.

(7). Mineral Waters.

EXETER, 1880. CARTER & Co., *Old Refinery, Bristol*, for Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic.

CROYDON, 1879. EVANS & Co., *Wrexham*, for Zoedone. (Patentee David Johnson, F.C.S.)

CROYDON, 1879. GULLIVER & Co., *Aylesbury*, for Lemonade, Lime Juice, and Ginger Ale.

STAFFORD, 1878. JEWSBURY & BROWN, *Manchester*, for Seltzer Water.

CROYDON, 1879. NEWRY MINERAL WATER COMPANY (LIMITED), *Liverpool* for Ginger Ale and Lemonade.

EXETER, 1880. SKINNER, G. H., 13, *North Street, Exeter*, for Seltzer, Soda, and Potash Waters, and Orange Quinine Tonic.

(8). Disinfectants.

Croydon, 1879. Calvert, F. C. & Co., *Bradford*, for Carbolic Acid.

Exeter, 1880. Calvert, F. C. & Co., *Bradford*, for Carbolic Acid and preparations of it.

Croydon, 1879. Jeyes' Sanitary Compound Company, *Bishopsgate Street, E.C.*, for Jeyes' Perfect Purifier.

Newcastle, 1882. Jeyes' Sanitary Compound Company, *London*, for Jeyes' Perfect Purifier.

(9) Disinfecting Apparatus.

Exeter, 1880. Calvert, F. C., & Co., *Bradford*, for Improved Vaporiser for Disinfecting.

Newcastle, 1882. Maguire & Son, *Dublin*, for Dr. Scott's Disinfecting Apparatus.

Newcastle, 1882. Manlove, Alliott, Fryer, & Co., *Nottingham*, for Lyon's Patent Disinfector.

CLASS V.—MISCELLANEOUS.

Articles of Sanitary Interest not included in the above Classes, such as :—

(1). Scientific Instruments.

Exeter, 1880. Bird, P. Hinckes, 1, *Norfolk Square, N.W.*, for Large Legible Spirit Thermometer.

Newcastle, 1882. Brady & Martin, *Newcaslte-upon-Tyne*, for their exhibit of Instruments used by Medical Officers of Health.

Newcastle, 1882. Davis, Joseph & Co., *London*, for New Oven Pyrometer.

Stafford, 1878. Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Thermometrical Instruments.

Croydon, 1879. Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Barometrical and Thermometrical Instruments.

Exeter, 1880. Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Improvements in Thermometrical and Barometrical Instruments.

Croydon, 1879. Webster & Co., *Nottingham*, for Webster's Patent Photometer.

(2). Books on Sanitation.

Stafford, 1878. Ladies' Sanitary Association, *Berners Street, W.*, for their Publications.

Newcastle, 1882. Smith, Elder, & Co., *London*, for their Exhibit of Sanitary Publications.

(3). Prevention of Accidents.

CROYDON, 1879. SELIG, SONNENTHAL & CO. (Limited), *Lambeth Hill, Queen Victoria Street, E.C.*, for Patent Safety Belt Shippers.

CROYDON, 1879. SINCLAIR, J., 104, *Leadenhall Street, E.C.*, for Chemical Fire Exterminator.

(4). Methods for the Disposal of the Dead.

STAFFORD, 1878. LONDON NECROPOLIS COMPANY, *Strand, W.C.*, for Patent "Earth to Earth" Coffins.

CROYDON, 1879. STRETTON, S., *Kidderminster*, for a Folding Bier and Car for Simplifying Funerals.

ALPHABETICAL LIST OF MEDALS AWARDED AT THE EXHIBITIONS.

RICHARDSON MEDAL.

Messrs. Mather & Armstrong, *Newcastle-upon-Tyne*, for Siemens's Regenerative Gas Burner.	Newcastle,	1882.
Silicate Paint Company, *Cannon Street, E.C.*, for Griffiths' Patent White.	Stafford,	1878.

SILVER MEDAL.

Offered by the Exeter Gas Company.

Sanitary and Economic Supply Association for Dr. Bond's Euthermic Ventilating Gas Stove.	Exeter,	1880.

Aveling & Porter, *Rochester*, for Improved Six-Ton Steam Road Roller.	Croydon,	1879.
Bean, A. T., 5, *Cannon Row, S.W.*, for Direct Acting Valveless Waste Preventer.	Exeter,	1880.
Billing & Co., *Hatton Garden, E.C.*, for Apparatus for Cooking by Gas.	Stafford,	1878.
Borwell, J., *Britannia Foundry, Burton-on-Trent*, for Improved Washer, with table complete.	Leamington,	1877.
Bostel, D. T., *Duke Street, Brighton*, for Excelsior Water Closet.	Leamington,	1877.
Bradford, T. & Co., *High Holborn, W.C.*, for New Patent "Shuttle" Steam Power Washing Machine.	Leamington,	1877.
Bradford, Thomas & Co., *London*, for Washing Machines.	Newcastle,	1882.
British Sanitary Company, *Glasgow*, for Dry Earth Closet.	Newcastle,	1882.
Calvert & Co., *Bradford, Manchester*, for Calvert's Carbolic Acid for disinfecting purposes.	Leamington,	1877.
Carter, J., 6*a*, *Cavendish Street, W.*, for Invalid Furniture.	Exeter,	1880.
Chorlton & Dugdale, *Manchester*, for Excelsior Spring Mattress.	Leamington,	1877.

Colman & Glendenning, *Norwich*, for School Furniture.	Exeter,	1880.
Doulton & Co., *Lambeth*, *London*, for Stanford's Patent Joints for Stoneware Pipes.	Stafford,	1878.
Doulton & Co., *Lambeth*, *London*, for Anti-Percussion High Pressure Valves.	Croydon,	1879.
Doulton & Co., *Lambeth*, *London*, for Ventilating Tile Stove.	Exeter,	1880.
Duncan, Maj. F., *The Common*, *Woolwich*, for Ambulance Wheeled Litter.	Stafford,	1878.
Ellison, J. E., *Leeds*, for Conical Ventilators.	Stafford,	1878.
Fraser Bros., *Commercial Road*, *E.*, for Portable Disinfecting Apparatus.	Croydon,	1879.
Galbraith, T., *Crawford Square*, *Londonderry*, for Hot-Air Bath.	Leamington,	1877.
Hamilton & Co., *Leadenhall Street*, *E.C.*, for Patent Prismoidal Pavement and Floor Lights.	Croydon,	1879.
Hancock, F. & C., *Dudley*, *Worcester*, for Machine for Washing and Cooling Butter.	Leamington,	1877.
Haresceugh, B. B. & Co., *Bentinck Street*, *Leeds*, for Excreta Pail (oak) with Spring Lid.	Leamington,	1877.
Harris, G. H., *Bristol Street*, *Birmingham*, for Economical Cooking Range.	Leamington,	1877.
Hassall & Singleton, *Birmingham*, for Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas.	Stafford,	1878.
Hayward, Tyler & Co., *London*, for Full-flush Valveless Closet.	Newcastle,	1882.
Hunt, Nathan, *Bristol*, for Auto-Pneumatic Ventilation.	Exeter,	1880.
Lascelles, W., *Bunhill Row*, *E.C.* for Concrete Bath in one piece.	Croydon,	1879.
Le Grand & Sutcliffe, *Bunhill Row*, *E.C.*, for Improvements in Well Sinking Apparatus.	Leamington,	1877.
Leoni, S. & Co., *Strand*, for Apparatus for Cooking by Gas.	Stafford,	1878.
Maignen, P. A., *Great Tower Street*, *E.C.*, for Filtre Rapide.	Croydon,	1879.
Manlove, Alliott, Fryer & Co., *Nottingham*, for Fryer's Patent Destructor, Fryer's Patent Carbonizer, and Firman's Patent Dessicating and Rendering Apparatus.	Newcastle,	1882.
Mather & Armstrong, *Newcastle-upon-Tyne*, for Sieman's Patent Regenerative Gas Burner.	Newcastle,	1882.
Moore, J., *St. James' Walk*, *Clerkenwell*, *E.C.*, for Glass Louvre Ventilators.	Exeter,	1880.
Morris, Little & Co., *Doncaster*, for Little's Soluble Phenyle.	Stafford,	1878.

Moser, L., *Southampton*, for Dry Closet, suitable for Ashes or Disinfecting Powder.	Exeter,	1880.
Moule's Patent Earth Closet Company, 5a, *Garrick Street, W.C.*, for their Earth Closets.	Stafford,	1878.
Parker, J., *Woodstock, Oxford*, for Dry Earth Closet.	Leamington,	1877.
Pocock, Bros., *Southwark Bridge Road*, for Universal Invalid Tubular Water and Air Bed.	Stafford,	1878.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Economic Hollow Flooring.	Stafford,	1878.
Read, Jefferson, *Birmingham*, for Arcanum Process of Silver Plating Steel.	Croydon,	1879.
Ross, J. A. G , *Newcastle-upon-Tyne*, for Silicate Cotton (Slag-wool).	Newcastle,	1882.
Sanitary Appliance Company, *Salford*, for Sifting Ash Closet, with Soil Pail.	Stafford,	1878.
Sanitary & Economic Supply Association, *Gloucester*, for Dr. Bond's Euthermic Gas Stove.	Exeter,	1880.
Silicate Paint Company, *Cannon Street, E.C.*, for Griffiths' Patent White, and for their preparations of Silicate Paint, Enamel Paint, and Petrifying Liquids.	Stafford,	1878.
Sinclair, J., *Leadenhall Street, E.C.*, for Tyndall's Smoke Respirator.	Croydon,	1879.
Societé Française D'Hygiene, *Paris*, for Chemical Preparations and Apparatus.	Leamington,	1877.
Societé Française d'Hygiène, *Paris*, for their exhibit of Books on Hygiène.	Newcastle,	1882.
Spongy Iron Water Purifying Company, *Oxford Street, W.C.*, for Bischof's Spongy Iron Filter.	Leamington,	1877.
Stott, James & Co., *Oldham*, for Patent Mercury Gas Governor.	Newcastle,	1882.
Tylor & Sons, *Newgate Street, E.C.*, for Flushing Rim Lavatory Basin and Apparatus.	Exeter,	1880.
Walker, Chas. W., *Wandsworth Common*, for Acid Pump and Syphon.	Croydon,	1879.
Ward, O. D., *London*, for Household Water Closet.	Newcastle,	1882.
Webb, H. Chalk, *Worcester*, for Colouring Patterns through the Substance of Wood.	Exeter,	1880.
Wenham, W. P., *Church Street, Croydon*, for an Improved Open or Close Range Kitchener.	Croydon,	1879.
Wilkinson, W. B. & Co., *Newcastle-upon-Tyne*, for Damp-proof Concrete Pavement.	Newcastle,	1882.
Willcocks & Co., *Burmantofts, Leeds*, for Silica Glazed and Enamelled Fire Clay Bricks and Faience.	Croydon,	1879.

WILSON ENGINEERING COMPANY, *Holborn, W.C.*, for Wilson Portable Close Cooking Range.	EXETER,	1880.
WILSON ENGINEERING COMPANY, *London*, for improved Wilson Range, with Steel Boiler and non-conducting Jacketting.	NEWCASTLE,	1882.
WOOLAMS & Co., *High Street Marylebone*, for Paper Hangings free from Arsenic.	CROYDON,	1879.

ALPHABETICAL LIST OF CERTIFICATES AWARDED AT THE EXHIBITIONS.

* Medal Awarded at a Previous Exhibition.

ADAMS, R., 7, *Great Dover Street, S.E.*, for Adjustable Shoe, and Regulating Spring Hinge for Swinging Doors.	CROYDON,	1879.
ADAMS, R., 7, *Great Dover Steeet, S.E.*, for Fanlight Openers and Casement Fasteners.	CROYDON,	1879.
ALLEN, THOMAS, *St. Augustine's Parade, Bristol*, for Metallic Tubular Bedsteads and Invalid Bedrests.	STAFFORD,	1878.
ANGELL, A. T., *London*, for Patent Air-tight Man-hole Door.	NEWCASTLE,	1882.
ARDEN, HILL & Co., *Birmingham*, for Solid Flame Boiling Stove.	NEWCASTLE,	1882.
BALL, ANCELL, *Spalding*, for Folding Invalid Bed.	CROYDON,	1879.
BARTRUM, HARVEY, & Co., *London*, for Patent Ventilatorium Waterproof Garments.	STAFFORD,	1878.
BEARD, DENT, & HELLYER, 21, *Newcastle Street. W.C.*, for Artizan Closet.	CROYDON,	1879.
BEARD, DENT, & HELLYER, 21, *Newcastle Street, W.C.*, for Patent Ventilating Drain Syphon.	CROYDON,	1879.
BIRD, PETER HINCKES, 1, *Norfolk Square, N.W.*, for his Method of Costless Ventilation.	CROYDON,	1879.
BIRD, PETER HINCKES, 1, *Norfolk Square, N.W.*, for Large Legible Spirit Thermometer.	EXETER,	1880.
*BILLING & Co., *Hatton Garden, E.C.*, for the "Workman's" Cooking Stove, and other Improvements in Gas-Cooking Stoves.	CROYDON,	1879.
*BOSTEL, D. T., *Duke Street, Brighton*, for "Excelsior" Water Closet.	STAFFORD,	1878.
BOWDEN, WILLIAM, *London*, for Patent Automatic Chariot for Children.	NEWCASTLE,	1882.
*BRADFORD, THOMAS & Co., *Salford*, for Shuttle Steam-Power Washing Machine.	STAFFORD,	1878.
BRADY & MARTIN, *Newcastle-upon-Tyne*, for Central Tube Water Mattress.	NEWCASTLE,	1882.
BRADY & MARTIN, *Newcastle-upon-Tyne*, for their exhibit of Instruments used by Medical Officers of Health.	NEWCASTLE,	1882.

BRAITHWAITE & Co., *Leeds*, for Patent Syphon for Water Closet Cisterns.	CROYDON,	1879.
BRANKSEA ISLAND POTTERY COMPANY (LIMITED) *Pool, Dorset*, for Stoneware Pipes.	EXETER,	1880.
BRITISH SANITARY COMPANY, *Glasgow*, for Self-Acting Earth Closet	EXETER,	1880.
BROCK, WILLIAM, & Co., 177, *Fore Street, Exeter*, for Bed Rest with Movable Arms.	EXETER,	1880.
BROCK, WILLIAM, & Co., 177, *Fore Street, Exeter*, for "Nonsuch" Adjustable Chair.	EXETER,	1880,
BRAY & Co., *Blackman Lane, Leeds*, for Improved Gas Burners.	CROYDON,	1879.
BUCHAN, W. P., *Glasgow*, for Improved Drain-pipe, with Access Cover.	NEWCASTLE,	1882.
BUCHAN, W. P., *Glasgow*, for Patent Disconnecting Drain-trap.	NEWCASTLE,	1882.
BUSSEY & Co., *Museum Works, Peckham, S.E.*, for Patent Spring Mattress.	CROYDON,	1879.
CALVERT, F. C., & Co., *Bradford*, for Carbolic Acid.	CROYDON,	1879.
CALVERT, F. C., & Co., *Bradford*, for Carbolic Acid and preparations of it.	EXETER,	1880.
CALVERT, F. C., & Co., *Bradford*, for Improved Vaporiser for Disinfecting.	EXETER,	1880.
CANDY & Co., *Newton Abbot*, for Granite Vitrified Bricks and Paving.	EXETER,	1880.
CAPPER, SON & Co., *London*, for Brian Jones's Patent Joint for connecting Closet with Soil-pipe.	NEWCASTLE,	1882.
CARTER & Co., *Old Refinery, Bristol*, for Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic.	EXETER,	1880.
*CHORLTON & DUGDALE, *Manchester*, for "Excelsior" Spring Mattress.	STAFFORD,	1878.
*CHORLTON & DUGDALE, *Manchester*, for "Excelsior" Spring Mattress Hospital Bed.	CROYDON,	1879.
CHORLTON & DUGDALE, *Manchester*, for "Sunlight Stove."	EXETER,	1880.
CHORLTON & DUGDALE, *Manchester*, for "Invalids'" Adjustable Bed.	EXETER,	1880.
*CHORLTON & DUGDALE, *Manchester*, for "Excelsior" Spring Mattress.	EXETER,	1880.
*CHORLTON & DUGDALE, *Manchester*, for "Excelsior" Spring Mattress.	NEWCASTLE,	1882.
CLARKE, F. W., PORTABLE GAS APPARATUS COMPANY (LIMITED), *Great Queen Street, W.C.* for Patent Portable Gas Apparatus for Manufacturing Gas from Gasoline.	CROYDON,	1879.
COLMAN & GLENDENNING, *Norwich*, for School Desks with Shifting Seats.	STAFFORD,	1878.

COLMAN & GLENDENNING, *Norwich*, for Patent Automaton Seat for Drapers.	EXETER,	1880.
COMPOSTELLA FIRE-LIGHT COMPANY, *Fenchurch Street, E.C.*, for the Compostella Fire Lights for Lighting Fires.	STAFFORD,	1878.
CONSTANTINE, T. J., *Fleet Street, E.C.*, for the Devonshire Cooking Range	EXETER,	1880.
CRAIG, J. & M., *Kilmarnock*, for Buchan's Patent Trap.	EXETER,	1880.
CRAIG, J. & M., *Kilmarnock*, for Maguire's Patent Cradle Joint for Drain-pipes.	NEWCASTLE,	1882.
CRAIG, J. & M., *Kilmarnock*, for Buchan's Patent Drain-trap and Drain-pipes, with Access Cover.	NEWCASTLE,	1882.
CRAIG, J. & M., *Kilmarnock*, for White Enamelled Fire Clay Sinks.	NEWCASTLE,	1882.
CREGEEN, H. S., *Bromley*, for Patent Air Inlet Head for Drain Ventilation.	NEWCASTLE,	1882.
DAVIS, JOSEPH & CO., *London*, for New Oven Pyrometer.	NEWCASTLE,	1882.
DINNING & COOKE, *Newcastle-upon-Tyne*, for Cast Iron Channels for Stable Drainage.	NEWCASTLE,	1882.
DINNING & COOKE, *Newcastle-upon-Tyne*, for George's Calorigen.	NEWCASTLE,	1882.
DINNING & COOKE, *Newcastle-upon-Tyne*, for Jennings's Universal Shampooing Apparatus.	NEWCASTLE,	1882.
DINNING & COOKE, *Newcastle-upon-Tyne*, for their exhibit of Grates, Mantel-pieces, and Over-mantels.	NEWCASTLE,	1882.
DOULTON & CO., *Lambeth, London*, for Decorative Tiles for Covering Walls and Floors.	CROYDON,	1879.
DOULTON & CO., *Lambeth, London*, for Disconnecting Gully, with back and side Entrances and iron grating.	CROYDON,	1879.
DOULTON & CO., *Lambeth, London*, for an Economical Flush-Out Closet.	EXETER,	1880.
*DOULTON & CO., *Lambeth, London*, for Anti-percussion High Pressure Draw-off Valves.	EXETER,	1880.
*DOULTON & CO., *Lambeth, London*, for Stanford's Patent Joints for Stoneware Pipes.	EXETER,	1880.
DOULTON & CO., *London*, for Anti-percussion High-pressure Bib Valves.	NEWCASTLE,	1882.
DOULTON & CO., *London*, for Bath Locking Valves, for preventing waste of water.	NEWCASTLE,	1882.
DOULTON & CO., *London*, for Latham's Flap Valve.	NEWCASTLE,	1882.
DOULTON & CO., *London*, for Patent Joint for Drain-pipes.	NEWCASTLE,	1882.

DOULTON & Co., *London*, for Reversible Inlet Gully, with Dished Stoneware Cover and Iron Grating.	NEWCASTLE,	1882.
DOULTON & Co., *London*, for their Flush-out Closet.	NEWCASTLE,	1882.
DOULTON & Co., *London*, for Tip-up Lavatory Basin.	NEWCASTLE,	1882.
*DOULTON & Co., *London*, for Ventilating Tile Stoves.	NEWCASTLE,	1882.
EDWARDS, J. C., *Trefynant*, *Ruabon*, for Dean's Patent External Drain Traps, with movable receptacle.	CROYDON,	1879.
*ELLISON, J. E., *Victoria Square*, *Leeds*, for Conical Ventilators.	CROYDON,	1879.
EVANS & Co., *Wrexham*, for Zoedone. (Patentee David Johnson, F.C.S.)	CROYDON,	1879.
FELL, J. & Co., *Wolverhampton*, for Clark's Patent Anti-splash Tip-up Lavatory Basin.	NEWCASTLE,	1882.
FELL, J. & Co., *Wolverhampton*, for Smith's Patent Cast Lead Syphon Traps.	NEWCASTLE,	1882.
FELL, J. & Co., *Wolverhampton*, for their exhibit of Water-taps.	NEWCASTLE,	1882.
FINCH & Co., 181, *High Holborn*, *W.C.*, for large Way Waste Plug, with Protective Cover.	CROYDON,	1879.
FORREST, WILLIAM, *Newcastle-upon-Tyne*, for the Albo Carbon Light.	NEWCASTLE,	1882.
FRY, J. S., & SONS, *Union Street*, *Bristol*, for Cocoa Extract and Preparations of Chocolate.	EXETER,	1880.
GARTON & KING, *Exeter*, for Vowel E. Bradford's Family Washing Machine.	EXETER,	1880.
GILLOW & Co., *Oxford Street*, *W.*, for Lavatory.	STAFFORD,	1878.
GULLIVER & Co., *Aylesbury*, for Lemonade, Lime Juice, and Ginger Ale.	CROYDON,	1879.
HAMILTON, W., *Brighton*, for Invalid "Grasshopper" Couch.	STAFFORD,	1878.
HAMILTON, WILLIAM, *Brighton*, for Invalid "Grasshopper" Couch.	NEWCASTLE,	1882.
HAMMOND & HUSSEY, *High Street*, *Croydon*, for Hornibrook's Patent Catchment Grating for Steep Gradients.	CROYDON,	1879.
*HANCOCK, F. & C., *Dudley*, *Worcester*, for Machine for Washing and Cooling Butter.	STAFFORD,	1878.
HANCOCK, F. & C., *Dudley*, *Worcester*, for New Propellor Churn.	EXETER,	1880.
HANCOCK, F. & C., *Dudley*, *Worcester*, for Dough Kneading Machine.	EXETER,	1880.
HANCOCK, F. & C., *Dudley*, for Patent Machine for Washing and Peeling Potatoes.	NEWCASTLE,	1882.

*HARESCEUGH, B. B. & Co., *Leeds*, for Excreta Pail (oak) with Patent Spring Lid.	STAFFORD,	1878.
HARRIMAN, W. & Co., *Blaydon-upon-Tyne*, for Fowler's Patent Water-closet.	NEWCASTLE,	1882.
*HARRIS, G. H., *Bristol Street, Birmingham*, for Economical Cooking Range.	STAFFORD,	1878.
HAYWARD, TYLER & Co., *London*, for Shower and Douche Bracket.	NEWCASTLE,	1882.
HEADLEY & SONS, *Cambridge*, for Patent Hose Reel.	CROYDON,	1879.
HERON, T., *Manchester*, for Patent Duplex Burner.	NEWCASTLE,	1882.
HILTON, W. H., *Leamington*, for various Inventions for Promoting Domestic Economy.	STAFFORD,	1878.
HUTCHINSON, A. & Co., *Great Winchester Street, E.C.*, for India Rubber Gas Tubing.	EXETER,	1880.
HYGIENIC STOVE AND GRATE COMPANY, 15, *Peel Buildings, Birmingham*, for "Eagle" Sanitary Trap, for superseding Bell Traps.	CROYDON,	1879.
JENNINGS, G., *Stangate, London*, for "Artizans' Dwellings Sink."	CROYDON,	1879.
JENNINGS, G., *Stangate, London*, for Universal Shampooing Apparatus.	CROYDON,	1879.
JEWSBURY & BROWN, *Manchester*, for Seltzer Water.	STAFFORD,	1878.
JEYES' SANITARY COMPOUND COMPANY, *Bishopsgate Street, E.C.*, for Jeyes' Perfect Purifier.	CROYDON,	1879.
JEYES' SANITARY COMPOUND COMPANY, *London*, for Jeyes' Perfect Purifier.	NEWCASTLE,	1882.
KIRSOP & Co., *Newcastle-upon-Tyne*, for Paragon Washing Machine, with Canadian Washer.	NEWCASTLE,	1882.
KNELL, U., 77, *Fore Street, E.C.*, for "Imperial" Ventilating Window.	CROYDON,	1879.
LADIES' SANITARY ASSOCIATION, *Berners Street, W.*, for their Publications.	STAFFORD,	1878.
LARMOUTH, THOMAS, & Co., *Salford*, for Dual Desk, with Separate Gangway Seat.	STAFFORD,	1878.
*LASCELLES, W., 121, *Bunhill Row, London*, for Concrete Bath, in one piece.	EXETER,	1880.
*LE GRAND & SUTCLIFFE, 100, *Bunhill Row, London*, for Improvements in Internal driving of Tube Wells.	CROYDON,	1879.
LEONI, S. & Co., *Strand, W.C.*, for the "Rheometer" Street Lamp Regulator.	STAFFORD,	1878.
LEWIS, MRS. A., *Manchester*, for Tin Cooking Utensils.	CROYDON,	1879.
LONDON NECROPOLIS COMPANY, *Strand, W.C.*, for Patent "Earth to Earth" Coffins.	STAFFORD,	1878.
MAGUIRE & SON, *Dublin*, for Dr. Scott's Disinfecting Apparatus.	NEWCASTLE,	1882.

Maignen, P. A., 20 & 23, *Great Tower Street, E.C*,, for "Bijou" Filtre Rapide.	Exeter,	1880.
*Maignen, P.A., 20 & 23, *Great Tower Street, E.C.*, for Filtre Rapide.	Exeter,	1880.
Maling, C. T., *Newcastle-upon-Tyne*, for his exhibit of Sanitary Earthenware.	Newcastle,	1882.
Maling, C. T., *Newcastle-upon-Tyne*, for Lavatory Basin with Flushing Rim.	Newcastle,	1882.
Manlove, Alliott, Fryer & Co., *Nottingham*, for Lyon's Patent Disinfector.	Newcastle,	1882.
Mather & Armstrong, *Newcastle-upon-Tyne*, for Hink's Patent Duplex Lamp, with Extinguisher.	Newcastle,	1882.
Mather & Armstrong, *Newcastle-upon-Tyne*, for Steam Heating Apparatus, combining heating and ventilating.	Newcastle,	1882
Mitchell, James, *Newcastle-upon-Tyne*, for Mitchell's Patent Steam Washer.	Newcastle,	1882.
McCallum, J. B., *Stafford*, for Improved Non-Absorbent Tub or Pail Van.	Exeter,	1880.
*Moule's Patent Earth Closet Company (Limited), 5*a*, *Garrick Street*, *W.C.*, for Earth Closet.	Croydon,	1879.
Murton, H. A., *Newcastle-upon-Tyne*, for exhibit of Indiarubber Vessels for hospital use.	Newcastle,	1882.
Nailsworth Foundry Company, *Bristol*, for Morgan's Stench Exhaust.	Newcastle,	1882.
Newry Mineral Water Company (Limited), *Liverpool*, for Ginger Ale and Lemonade.	Croydon,	1879.
Oates & Green, *Horley Green Fire Clay Works*, *Halifax*, for Patent Drain-cleaning Rods and Stoneware Horse Manger.	Stafford,	1878.
Onions, J. C., (Limited), *Birmingham*, for Moser's Patent Self-Acting Dry Closet.	Croydon,	1879.
Parker, J., *Woodstock*, for Dry Earth Commode without Separator.	Exeter,	1880.
Patent Victoria Stone Company, *Kingsland Road, E.*, for Artificial Stone Tubes.	Croydon,	1879.
*Pocock Bros., *Southwark Bridge Road, S.E.*, for "Universal" Tubular Air and Water Bed.	Croydon,	1879.
Potts & Co., *Handsworth*, *Birmingham*, for Edinburgh Air-Chambered Sewer Trap.	Stafford,	1878.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Warming and Ventilating Appliances.	Stafford,	1878.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Thermometrical Instruments.	Stafford,	1878.

*Pritchett, G. E., 20, *Spring Gardens. S.W.*, for Improvements in Hollow Tile Flooring.	Croydon,	1879.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Barometrical and Thermometrical Instruments.	Croydon,	1879.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Corrugated Iron Hot-Water Warming Appliances.	Exeter,	1880.
Pritchett, G. E., 20, *Spring Gardens, S.W.*, for Improvements in Thermometrical and Barometrical Instruments.	Exeter,	1880.
Ransome, S. E., & Co., 10, *Essex Street, W.C.*, for "Milwaukee" Glass Lantern or Hurricane Lantern.	Croydon,	1879.
Rimington Bros. & Co., *Newcastle-upon-Tyne*, for Dean's Gully Trap.	Newcastle,	1882.
Rimington Bros. & Co., *Newcastle-upon-Tyne*, for Enamelled Fire Clay Bath.	Newcastle,	1882.
Ruffard & Co., *Clay Works*, *Stourbridge*, for Porcelain Baths, moulded and glazed in one piece.	Stafford,	1878.
*Salmon, Barnes & Co., *Ulverston*, for Revolvng Shutters with Patent Balance Weight Motion.	Exeter,	1880.
*Sanitary Appliance Company, *Factory Lane*, *Salford*, for Patent Cinder-Sifting Ash Closet.	Croydon,	1879.
Selig, Sonnenthal & Co. (Limited), *Lambeth Hill*, *Queen Victoria Street*, *E.C.*, for Patent Safety Belt Shippers.	Croydon,	1879.
Sharp, Jones & Co., *Bourne Valley Pottery*, *Poole*, *Dorset*, for Rock Concrete Tubes.	Croydon,	1879.
Sharp, C. H. & Co., *High Holborn*, *E.C.*, for Ornamental Inlet Ventilators.	Exeter,	1880.
Shone, Isaac, *Wrexham*, for Pneumatic Liquid Ejector.	Stafford,	1878.
Silicated Carbon Filter Company, *Battersea*, for Silicated Carbon Double Chambered Table Filters.	Exeter,	1880.
Silicated Carbon Filter Company, *London*, for Silicated Carbon Filtering Material.	Newcastle,	1882.
Sinclair, J., 104, *Leadenhall Street*, *E.C.*, for Chemical Fire Exterminator.	Croydon,	1879.
Skinner, G. H., 13, *North Street*, *Exeter*, for Seltzer, Soda, and Potash Waters, and Orange Quinine Tonic.	Exeter,	1880.
Smith, Elder & Co., *London*, for their exhibit of Sanitary Publications.	Newcastle,	1882.
Smith, James, *Liverpool*, for Open Grate for consuming Smoke.	Newcastle,	1882.

SNELL, H. SAXON, *Southampton Buildings*, for the Thermhydric Ventilating Hot-Water Open Fire Grate.	STAFFORD,	1878.
STEPHAN, J. A., *Worcester*, for Carbonised Iron Stone Mound Filter for Water.	EXETER,	1880.
STIDDER & Co., 50, *Southwark Bridge Road, S.E.*, for Swivel, Lock Plug, and Overflow for Sink.	CROYDON,	1879.
STIFF, JAMES, & SONS, *Lambeth, London*, for Weaver's Ventilating Sewer Air Trap.	STAFFORD,	1878.
STRAKER & LOVE, *Newcastle-upon-Tyne*, for their exhibit of large Fire-clay Drain-pipes.	NEWCASTLE,	1882.
STRETTON, S., *Kidderminster*, for a Folding Bier and Car for Simplifying Funerals.	CROYDON,	1879.
THOMASSON & KEY, *Worcester*, for Cup Grating for Sinks.	NEWCASTLE,	1882.
THORN & Co., *Stafford*, for Artificial Stone Filters, for Cleansing Rain Water for Domestic Use.	STAFFORD,	1878.
THORNBURN, WILLIAM, *Borough Bridge*, for Tubular Calorifer for Greenhouses.	NEWCASTLE,	1882.
TOWNSEND & Co., *Newcastle-upon-Tyne*, for their exhibit of China Cups and other Vessels for Invalid use.	NEWCASTLE,	1882.
TYLOR, J., & SONS, 2, *Newgate Street, E.C.*. for "Clear Way" Regulator Valve Water Closet, without overflow communicating with Valve Box.	EXETER,	1880.
TYLOR, J., & SONS, 2, *Newgate Street, E.C.*, for Improved Enamelled Iron Slop Sink, with Patent Regulator Supply Valve.	EXETER,	1880.
TYLOR, J., & SONS, 2, *Newgate Street, E.C.*, *for* Improved Full-Way Stop Valve.	EXETER,	1880.
TYLOR, J. & SONS, 2, *Newgate Street, E.C.*, for "Waste Not" Regulator Valve.	EXETER,	1880.
TYLOR, J. & SONS., *London*, for Hospital Slop Sink, with Patent Waste-not Regulator Valve.	NEWCASTLE,	1882.
TYLOR, J. & SONS, *London*, for Bath Locking Valves for preventing waste of water.	NEWCASTLE,	1882.
TYLOR, J. & SONS, *London*, for Flushing-rim Lavatory Basin, with Quick Waste.	NEWCASTLE,	1882.
TYLOR, J. & SONS, *London*, for Patent Flush-out Urinal Basin.	NEWCASTLE,	1882.
TYLOR, J. & SONS, *London*, for Patent Joint for Lead Pipes.	NEWCASTLE,	1882.
TYLOR, J. & SONS, *London*, for Terry's Patent Pedal-action for Water-closets.	NEWCASTLE,	1882.
TYLOR, J. & SONS, *London*, for Waste-not Regulator Valve.	NEWCASTLE,	1882.
WALLER, THOS., 47, *Fish Strert Hill, E.C.*, for Cooking Stove with Warm-Air Chamber.	CROYDON,	1879.

*Ward, O. D., *London*, for Bean's Direct Acting Valveless Waste Preventer.	Newcastle,	1882.
Watson, Henry & Son, *Newcastle-upon-Tyne*, for the "National" Water-closet.	Newcastle,	1882.
Watson, Henry & Son, *Newcastle-upon-Tyne*, for Waste-preventing Flushing Syphon.	Newcastle,	1882.
Watson, Henry & Son, *Newcastle-upon-Tyne*, for "Crown" Cottage Water-closet.	Newcastle,	1882.
White, William, *Abergavenny*, for Hygeian Rock Building Composition.	Newcastle,	1882.
Webster & Co., *Nottingham*, for Webster's Patent Photometer.	Croydon.	1879.
Wenham & Co., *Church Street*, *Croydon*, for Boyle's Mica-Valved Outlet Ventilator.	Croydon,	1879.
Willcock & Co., *Burmantofts*, *Leeds*, for Fire-Clay Sanitary Sinks, and Water Troughs.	Croydon,	1879.
Willey & Co., *Exeter*, for their Exhibit of Gaseliers and Gas Brackets.	Exeter,	1880.
*Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Moule's Earth Closet.	Exeter,	1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Ransome's Artificial Stone Air Brick.	Exeter,	1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Conservatory Boiler, with Hot-Water Pipe.	Exeter,	1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Cottage Range	Exeter,	1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Chappuis Daylight Reflector.	Exeter,	1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Fernby's "Paragon" Camp Furniture.	Exeter,	1880.
Wippell Bros. & Row, 231, *High Street*, *Exeter*, for Improved Housemaid's Box with Sifter.	Exeter,	1880.
*Woollams & Co., *London*, for Non-Arsenical Wall Papers.	Newcastle,	1882.
Wright & Stevens, for Syphon Flushing Cistern.	Newcastle,	1882.
Wright, John & Co., *Birmingham*, for the "Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing.	Newcastle,	1882.

PAPERS AND ADDRESS READ AT THE CONGRESSES OF THE INSTITUTE.

PRESIDENT'S ADDRESS.

B. W. Richardson, M.D., F.R.S. A Theory as to the Natural or Glandular Origin of the Contagious Diseases. LEAMINGTON, 1877

E. Chadwick, C.B. The need of reform in the Administrative Organisation of the Sanitary Service, with special reference to the Appointment of Medical Officers of Health. STAFFORD, 1878.

B. W. Richardson, M.D., F.R.S. Salutland, an Ideal of a Healthy People. CROYDON, 1879.

Earl Fortescue. Address to Congress. EXETER, 1880.

Captain Douglas Galton, R.E., C.B., D.C.L., F.R.S. Address to the Congress. NEWCASTLE-UPON-TYNE, 1882.

ADDRESSES TO SECTIONS.

Sir Antonio Brady.	President	Section	III.	Exeter,	1880.
Dr. Alfred Carpenter.	,,	,,	I.	Croydon,	1879.
Prof. F. S. B. F. de Chaumont, M.D., F.R.S.	,,	,,	I.	Exeter,	1880.
Dennis Embleton, M.D., F.R.C.S.	,,	,,	I.	Newcastle,	1882.
Capt. Douglas Galton, R.E., C.B., F.R.S.	,,	,,	II.	Croydon,	1879.
Arthur Mitchell, M.A., M.D., LL.D., F.R.S.	,,	,,	III.	Newcastle,	1882.
R. Rawlinson, C.B.	,,	,,	II.	Exeter,	1880.
Prof. Henry Robinson, M.Inst.C.E.	,,	,,	II.	Newcastle,	1882.
G. J. Symons, F.R.S.	,,	,,	III.	Croydon,	1879.

ADAMS, Miss Rose. Woman's Work in relation to Sanitary Science, LEAMINGTON. 1877.

Agnew, Thomas, F.G.S. Possibility of a Subterranean Supply of Water being found in Exeter. EXETER, 1880.

Arlidge, J. T., M.D., F.R.C.P. Some Hygienic Conditions of the Pottery Manufacture. STAFFORD, 1878.

Armstrong, H. E., M.R.C.S. Sketch of the Sanitary History of Newcastle-upon-Tyne. NEWCASTLE-UPON-TYNE, 1882.

BALBIRNIE, John, M.D., M.A. The best mode of replacing the Rookeries and Effete Tenements lately removed by the Corporation of London. STAFFORD, 1878.

Balbirnie, John, M.A., M.D. On the necessity for an Improved System of Ventilating, Heating, and Cooling Crowded Human Habitations or Places of Assembly; especially in Hot Seasons or Climates. CROYDON, 1879.

Bartlett, H. C., PH.D., F.C.S. Water for Domestic Use. LEAMINGTON, 1877.

Bartlett, H. C., PH.D., F.C.S. The Chemistry of Dirt. STAFFORD, 1878.

Bartlett, H. C., PH.D., F.C.S. Lecture to Working Classes. EXETER, 1880.

Bartlett, H. C., PH.D., F.C.S. On the Influence of Minute Suspended Matter on Health: its Detection, Collection, and Examination. NEWCASTLE-UPON-TYNE, 1882.

Bayley, Joseph S., M.R.C.S. Sanitary condition of Leamington. LEAMINGTON, 1877.

Birch, R. W. Peregrine, M.INST.C.E. Facts upon Sewage Farming. STAFFORD, 1878

Bird, Peter Hinckes, F.R.C.S. On Simplicity, Common Sense, and Intelligent Supervision in Sanitary Appliances. CROYDON, 1879

Boulnois, H. P., M.INST.C.E. Sewer-gas Annihilation. EXETER, 1880

Burdett, Henry C. The Dwellings of the Poor in Large Towns. LEAMINGTON, 1877.

Burdett, Henry C. Thames Water: its impurities, dangers, and contaminations. Remedy suggested. STAFFORD, 1878.

Burdett, Henry, C. On the Unhealthiness of Public Institutions. CROYDON, 1879

Burdett, Henry C., F.S.S. On the Necessity and Importance of Mortuaries for Towns and Villages, with some Suggestions for their Establishment and Management. EXETER, 1880.

Burdett, Henry C., F.S.S. The Unhealthiness of Public Institutions. EXETER, 1880.

CARPENTER, Alfred, M.D. The Lessons taught at the Exhibition. CROYDON, 1879.

Carpenter, Alfred, M.D. The Sanitary Aspects of Dress. NEWCASTLE-UPON-TYNE, 1882.

Carter, R. Brudenell, F.R.C.S. The Present Possibilities of Sanitary Legislation. LEAMINGTON, 1877.

Chadwick, Edwin, C.B. On the reduction of Infantile Mortality. CROYDON, 1879.

Chadwick, Edwin, C.B., and Lawson Tait. Work of the Birmingham Interception Sub-Committee. LEAMINGTON, 1877.

Chadwick, Edwin, C.B. On the Norma of Sanitation in the School Stages of Life. CROYDON, 1879.

Chadwick, Edwin, C.B. Circulation or Stagnation. EXETER, 1880.

Chisholm, J. Eleven Months of Cold Weather. CROYDON, 1879.

Clendinnen, W. Ellis, and James B. M'Cullum. The Sanitary Defects of Old Towns, and Suggested Remedies. STAFFORD, 1878.

Cole, Sir Henry, K.C.B. Sanitary Co-operation. STAFFORD, 1878.

Cooper, W. J., and Prof. Wanklyn. A new Process for Testing Air. STAFFORD, 1878.

Corden, Geo. On some of the apparent Influences of the Weather upon the prevalence or otherwise of certain classes of Disease. CROYDON, 1879.

Corfield, Prof. W. H., M.A., M.D., On Mistakes about Health. CROYDON, 1879.

Corfield, Prof. W. H., M.A., M.D. Sanitary Fallacies. CROYDON, 1879.

DAY, HENRY, F.R.C.P. Ozone in relation to Health and Disease. STAFFORD, 1878.

DE CHAUMONT, PROF. F. S. B. F., M.D., F.R.S. Influence of Climate on Health. LEAMINGTON, 1877.

DE CHAUMONT, PROF .F. S. B. F., M.D., F.R.S. Health and Good Food. CROYDON, 1879.

DE CHAUMONT, PROF. F. S. B. F., M.D., F.R.S. On certain points with reference to Drinking-Water. CROYDON, 1879.

DE CHAUMONT, PROF., F.S.B.F., M.D., F.R.S. On the Food and Energy of Man. NEWCASTLE-UPON-TYNE, 1882.

DE CROIX, M. Means of Prevention, and Cure of Hydrophabia. EXETER, 1880.

DENHAM, W. HEMPSON, F.L.S., F.S.S., The Sanitation and Draining of Towns, and Disposal of Sewage. CROYDON, 1879.

DENISON, VEN. ARCHDEACON. Supply and Storage of Water at East Brent. LEAMINGTON, 1877.

DENNIS, WILLIAM, M.INST.C.E. The Works in Progress for the Water Supply of Stafford. STAFFORD, 1878.

DENTON, BAILEY, M.INST.C.E. Remarks on certain points in the Work of the Engineer, which have a direct bearing on Public Health. CROYDON, 1879.

DOMENICHETTI, R., M.D. Notes on the Water Supply of the Louth Rural District. EXETER, 1880.

DYKE, T. J., F.R.C.S. Missing Links in the Sanitary Administrative Service. LEAMINGTON, 1877.

EASSIE, W., C.E., F.L.S. Cremation—A Sanitary Institution. LEAMINGTON, 1877.

EASSIE, W., C.E., F.L.S. Demonstrations of the various systems which have been adopted in late Cremations of the Human Body. LEAMINGTON, 1877.

EASSIE, W., C.E., F.L.S. The Effects of Growing Vegetation upon Human Health. LEAMINGTON, 1877.

EASSIE, W., C.E., F.L.S. The Sewerage of Ancient Rome. STAFFORD, 1878.

EASSIE, W., C.E., F.L.S. The Dangers of Bad Plumbing. CROYDON, 1879.

EASSIE, W., C.E., F.L.S., F.G.S. The Desirability or otherwise of Providing Town and Country Houses with Grease intercepting Chambers to Scullery Sinks. NEWCASTLE-UPON-TYNE, 1882.

ELLICE-CLARK, E. B., A.M.I.C.E. The Administration of Public Health Laws. STAFFORD, 1878.

ELLISON, J. E. Ventilation: Position of Inlets and Outlets. CROYDON, 1879.

ELLISON, R. CARR, J.P. The Influence of the Purity or Impurity of the External Atmosphere on Public Health, Public Comfort, and on the Domestic Habits of the People. NEWCASTLE-UPON-TYNE, 1882.

FOSTER, G. A. On the Self-Providing Sanitary Capabilities of Isolated Middle-Class Dwellings. EXETER, 1880.

FRANCIS, Surgeon-Gen., C. R. The Influence of efficient Sanitation in the Prevention of the Himalayan Plague. CROYDON, 1879

GALTON, CAPT. DOUGLAS, R.E., C.B., F.R.S. Health and Good Air. CROYDON, 1879.

GEARY, LIEUT.-COL., R.A. The advantage of Temperance for the maintenance of Military Force. STAFFORD, 1878.

GEARY, LIEUT.-COL., R.A. The special provision needed for the maintenance of Military Force by distinct Sanitary Service for the Army. STAFFORD, 1878.

GRANTHAM, R. B. Abattoirs. EXETER, 1880.

Grantham, R.B., M.INST.C.E. The Establishment of a Library for a Special Branch of Sanitary Information at Newcastle. NEWCASTLE-UPON-TYNE, 1882.

Green, Burton. Sewage Disposal and Sanitary Carbon. LEAMINGTON, 1877.

HARDWICKE, William, M.D. Public Mortuaries for Large Towns. STAFFORD, 1878.

Harris, A. E., L.R.C.S. Infantile Mortality. NEWCASTLE-UPON-TYNE, 1882.

Haviland, Alfred, M.R.C.S. Geology in relation to Sanitary Science. CROYDON, 1879.

Henderson, C. On Heating and Ventilating. CROYDON, 1879.

Heron, G. A., M.D. New method of preventing the entrance of Sewer Air into houses. STAFFORD, 1878.

Hildyard, Captain R. The Influence on Sanitary Progress which Medical Men might Exercise in their Private Practice. NEWCASTLE-UPON-TYNE, 1882.

Holden, J. Sinclair, M.D. Law or Caprice in Contagion. LEAMINGTON, 1877.

JONES, Lieut.-Col., V.C. Sewage, Sewerage, and Town Refuse. LEAMINGTON, 1877.

Jones, Lieut.-Col., V.C. The paramount importance of considering economy in all measures undertaken for Sewage Disposal. STAFFORD, 1878.

Jones, Lieut.-Col., V.C. On Sewage. EXETER, 1880.

KERR, Maj.-Gen., Lord Mark, C.B. Notes of early experiences in Army Sanitation. STAFFORD, 1878.

Kerr, Norman, M.D., F.L.S. Preventible Mortality. The Mortality from Alcohol. CROYDON, 1879.

Kingzett, F. C., F.C.S. On Nature's Hygiene. CROYDON, 1879.

Kinsey, W. Barnes. Particulars of an Artesian Well at Thames Haven. CROYDON, 1879.

LATHAM, Baldwin, M.INST.C.E., F.G.S. The Influence of the Movement of Subterraneous Water on Health. LEAMINGTON, 1877.

Lake, W. C., M.D, A Century of Death Rates at Teignmouth. EXETER, 1881.

Law, Henry, M.INST.C.E. The natural principle which should determine the boundaries of Drainage Districts. STAFFORD, 1878.

Laws, W. G., M.INST.C.E. Sewer Ventilation. NEWCASTLE-UPON-TYNE, 1882.

Lediard, H. A., M.D. Arsenic in Domestic Fabrics. NEWCASTLE-UPON-TYNE, 1882.

Lee, R., Junr. Sanitary Blunders, and Practical Schemes for their Removal. EXETER, 1880.

Lemon, J., M.INST.C.E. The Separate System of Drainage. NEWCASTLE-UPON-TYNE, 1882.

Liernur, Capt. Sewage Disposal. CROYDON, 1879.

Lucas, Joseph, F.G.S. On the Quantitative Elements in Hydrogeology. CROYDON, 1879.

MARSH, Lory, M.D. The Establishment of a School for the Technical Teaching of Sanitary Science. STAFFORD, 1878.

Marsh, Lory, M.D. On the Technical Work of the Sanitary Institute of Great Britain. CROYDON, 1879.

Marten, Henry J., M.INST.C.E. Some observations with respect to the Drainage of the Populous Manufacturing Towns situate upon the Drainage Area of the River Tame and its tributaries north of Birmingham, and as to the means to be adopted to prevent the present and future Pollution of that River. STAFFORD, 1878.

Marten, Henry J., M.INST.C.E. The works projected and undertaken during the last thirty years for the Supply of the principal Towns in the County of Staffordshire with Water. STAFFORD, 1878.

McCULLUM, J. B., and W. ELLIS CLENDINNEN. The Sanitary defects of Old Towns and suggested remedies. STAFFORD, 1878.

MELLISS, J. C., A.M.I.C.E. The necessity for employing more uniform terms in literature relating to Sewage Disposal. STAFFORD, 1878.

MILROY, GAVIN, M.D., F.R.C.P. Leprosy, and its prevention by Sanitary Means. STAFFORD, 1878.

MOFFAT, T., M.D., F.R.G.S. Turpentine and Terebine. LEAMINGTON, 1877.

MOLYNEUX, WILLIAM, F.G.S. River Inundations. STAFFORD, 1878.

MOLYNEUX, WILLIAM, F.G.S. The Water Supply of Stafford. STAFFORD, 1878.

MONCKTON, T., M.D. The blindness of householders to the Sanitary Condition of their own Houses. STAFFORD, 1878.

MONCKTON, T., M.D. The Periodical Sanitary Inspection of Houses. STAFFORD, 1878.

MONSON, E. The advantages of the separate system of sewage, with special reference to the Metropolis. STAFFORD, 1878.

NICHOLS, F. Infant Mortality. CROYDON, 1879.

NOURSE, W. E. Forty Cases of Illness following Sanitary Neglect. EXETER, 1880.

NOURSE, W. E. On the Past and Present Prevalence of Several Diseases, as Influenced by Food and by House Drainage. EXETER, 1880.

OGLE, W,, M.D., F.R.C.P. The Preventive System of Medical Practice. STAFFORD, 1878.

OGLE, W., M.D., F.R.C.P. Nurses: How to make them, how to use them, and how to pay them. CROYDON, 1879.

ORMSBY, A., M.INST.C.E. Artificial Collecting Grounds for Water Supply. STAFFORD, 1878.

PERKINS, F. P. On the Amount of Organic Impurity contained in the Water of the Exe. EXETER, 1880.

PERKINS, F. P. On the Sanitary Condition of Wells in Exeter and Neighbourhood. EXETER, 1880.

PILBROW, JAMES, M.INST.C.E. On the Separate System of Town Sewage. STAFFORD, 1878.

PORTER, T. H. The Softening and Purification of Water by the Process of the late Professor Clark; with a Notice of a System by which it is rendered more generally available. CROYDON, 1879.

PRICE, JOHN. Industrial Dwellings. NEWCASTLE-UPON-TYNE, 1882.

RAWLINSON, ROBERT, C.B., Chief Inspector of the Eng. Depart. of the Local Govt. Board. Sanitary Science. STAFFORD, 1878.

RICHARDSON, B. W., M.D., F.R.S. The constitution and function of a Ministry of Health for the United Kingdom. STAFFORD, 1878.

RICHARDSON, B. W., M.D., F.R.S. On Health at Home. CROYDON, 1879.

RICHARDSON, B. W., M.D., F.R.S. Woman as a Sanitary Reformer. EXETER, 1880.

RICHARDSON, B. W., M.D., LL.D., F.R.S. The Next to Godliness. NEWCASTLE-UPON-TYNE, 1882.

RIDGE, J. JAMES, M.D. The Relation of Alcohol to Bad Sanitation. CROYDON, 1879.

ROBINS, E. C., F.S.A. The Original Experiments of Dr. Renk, of Munich, with Sewer Gas, and the Mode of its Exclusion from Dwelling Houses. NEWCASTLE-UPON-TYNE, 1882.

ROBINSON, PROF. HENRY, M.INST C.E. Progress in Purifying Sewage by Precipitation. STAFFORD, 1878.

RUSSELL, J. A., M.A., M.B., Demonstration on the passage of Gasses through water in Traps—Lead Pipes corroded by Sewer Gas—Samples of improper plumbing taken out of Houses. LEAMINGTON, 1877.

RUSSELL, J. A., M.A., M.B. The necessity of Plumbers and Builders possessing a Competent Knowledge of the Laws of Health as bearing on their respective occupations. LEAMINGTON, 1877.

RUSSELL, J. A. M.A., M.B. Food and Drink. STAFFORD, 1878.

RUSSELL, The HON. F. A. ROLLO. The Improvement of Climate with Slight Elevation. NEWCASTLE-UPON-TYNE, 1882.

SERGEANT, EDWARD, L.R.C.P. The Compulsory Registration of Infectious Diseases, with special reference to its working at Bolton. STAFFORD, 1878.

SCOTT, MAJOR-GEN., H. Y. D., R.E., C.B., F.R.S. On the effects of the long-continued application of Sewage Water to the same Land. CROYDON, 1879.

SCOTT, MAJOR-GEN., H. Y. D., R.E., C.B., F.R.S. Suggestions on the Cleansing of Sewers. EXETER, 1880.

SHONE, ISAAC, ASSOC. M.INST.C.E., F.G.S. The New Pneumatic Sewerage System as compared with Captain Liernur's and existing Gravitation Systems. STAFFORD, 1878.

SLADE-KING, E. J., M.D. Sanitary Work in English Watering Places. LEAMINGTON, 1877.

SLADE-KING, E. J., M.D. Notes on the Spread of Diphtheria. EXETER, 1880.

SMITH, ANGUS, PH.D., F.R.S. The Progress of Air-Testing. STAFFORD, 1878.

SMITH, S. PARSONS, M.K.Q.C.P., L.R.C.S.I. The Necessity for a Permanent Registration of House Drains. CROYDON, 1879.

SOPER, WILLIAM, M.R.C.S. The Disinfection of Hospital Drains. STAFFORD, 1878.

SOPER, WILLIAM, M.R.C.S. Disinfection of Excreta. CROYDON, 1879.

STANLEY, WM. F., F.M.S. Conditions of the Water Supply of Croydon in relation to its Rainfall and Geology; with Suggestions for its Sanitary and Profitable Improvement. CROYDON, 1879.

STEPHENS, HENRY C., F.C.S. Observations upon Effective Ventilation. CROYDON, 1879.

STEPHENSON, F. C. On the Ventilation of Water Mains. EXETER, 1880.

STRONG, H. J., M.D. Health Out of Doors. CROYDON, 1879.

STRONG, H. J., M.D. On the Importance of thorough Ventilation in Dwellings. CROYDON, 1879.

SWETE, HORACE, M.D. New Artesian Water Supply at Leamington. LEAMINGTON, 1877.

SWETE, HORACE, M.D. Interpretation of Water Analysis for Drinking Purposes. CROYDON, 1879.

SYMONS, G. J., F.R.S. Health and Pure Water. CROYDON, 1879.

SYMONS, G. J., F.R.S. Some Deficiencies in our Knowledge respecting Health Resorts. EXETER, 1880.

TAIT, LAWSON, F.R.C.S. and E. CHADWICK, C.B. Work of the Birmingham Interception Sub-Committee. LEAMINGTON, 1877.

TURNER, ERNEST, F.R.I.B.A. Home, Sweet Home. LEAMINGTON, 1877.

TURNER, ERNEST, F.R.I.B.A. Hospitals for Infectious Diseases. STAFFORD, 1878.

VACHER, F. On Common Lodging-House Accommodation. CROYDON, 1879.

WALLIS, H. SOWERBY, F.M.S. Rain collected from Roofs considered as a Domestic Water Supply CROYDON, 1879.

WANKLYN, PROFESSOR, AND W. J. COOPER. A New Process for Testing Air. STAFFORD, 1878.

WARING, COL. G. E., junr. Sanitary Engineering in America. STAFFORD, 1878.

WARING, COL. G. E., junr. The Sewerage of Memphis, United States of America. EXETER, 1880.

WHITE, W., F.S.A. Treatment of Domestic Sewage. LEAMINGTON, 1877.

WHITE, W., F.S.A. Water-Closet Construction. EXETER, 1880.

WILSON, G., M.A., M.D. The Past and Future of Sanitary Science. LEAMINGTON, 1877.

WOODMAN, J., F.R.C.S. Exeter Sanatorium, with a few remarks on the importance of early isolation in cases of zymotic diseases. EXETER, 1880.

WOODMAN, W. R., M.D. The Plan adopted in St. Thomas's, Exeter, for disinfecting the Sewage of the District. EXETER, 1880.

WYATT-EDGELL, REV. E. The Diminution of Insanity which took place during the Political Commotions in France. LEAMINGTON, 1877.

WYATT-EDGELL, Rev. E. Some remarks on Hereditary Influence. CROYDON, 1879.

YATES, MISS. Bread Reform. NEWCASTLE-UPON-TYNE, 1882.

PAPERS AND ADDRESSES READ AT ANNIVERSARY AND ORDINARY MEETINGS.

BAZALGETTE, SIR JOSEPH, C.B. Mode of Treating Town Sewage. March 14, 1877.

BUCKLAND, FRANK, M.A. The Pollution of Rivers and its Effects upon the Fisheries and Water Supply of Towns and Villages (*Annual Address*). Anniversary Meeting, 1878.

BURDETT, HENRY C., F.S.S. The Administration and Hygiene of British Hospitals. Ordinary Meeting, February 15th, 1882.

CARPENTER, A., M.D. Inaugural Address. Ordinary Meeting, Dec 7, 1881.

CORFIELD, PROF. W. H., M.A., M.D. The present State of the Sewage. Question. Ordinany Meeting, June 21st, 1881.

DE CHAUMONT, PROF., M.D., F.R.S. Modern Sanitary Science (*Annual Address*) Anniversary Meeting, 1881.

DONALDSON, WILLIAM, M.A., M.INST.C.E. On the Present and Future Work of Engineers in reference to Public Health. May 31st, 1877.

GALTON, CAPT. DOUGLAS., R.E., C.B., F.R.S. On the Preventible Causes of Impurity in London Air. *(Annual Address.)* Anniversary Meeting 1880.

GARDNER, C. F. The Necessity for Further Sanitary Legislation, with special Reference to Mr. Sclater-Booth's Pollution of Rivers Bill. July 13th, 1877.

GASKOIN, G., M.R.C.S. The Range of Hereditary Tendencies in Health and Disease. Ordinary Meeting, March 8th, 1882.

MICHAEL, W. H., Q.C. The Law in relation to Sanitary Science. Ordinary Meeting, February 9th, 1881.

PROSPER DE PIETRA SANTA, DR. Consumption and Climate. July 6th, 1877.

RICHARDSON, B. W., M.D., LL.D., F.R.S. Future of Sanitary Science (*Annual Address*). Anniversary Meeting, 1877.

RICHARDSON, B. W., M.D., LL.D., F.R.S. Suggestions for the management of Cases of Small Pox, and other infectious diseases in the Metropolis and large Towns. Ordinary Meeting, April 13th, 1881,

ROBINS, E.C., F.S.A., F.R.I.B.A. The Work of the Sanitary Institute of Great Britain (*Annual Address*). Anniversary Meeting, 1882.

STEPHENS, HENRY C., F.S.S. On Obstruction by the Law to Sewage Disposal. Ordinary Meeting, April 19th, 1882.

SYMONS, G. J., F.R.S. Water Economy (*Annual Address*). Anniversary Meeting, 1879.

LIST OF DONATIONS.

LIST OF CONTRIBUTIONS TO THE LIBRARY DURING 1882-3.

Architects, Royal Institute of British Transactions 1881-2.	Royal Inst. of British Architects.
Armstrong, H. E., Report of the Medical Officer of Health on the Sanitary Condition of Newcastle-upon-Tyne 1875 to 1881.	H. E. Armstrong.
Blake, J. H., Address at the Anniversary Meeting of the Norwich Geological Survey.	J. H. Blake.
Browning, Benjamin, On Water as an Agent in the Spread of Diptheria.	Benjamin Browning.
Browning, Benjamin, Vaccination with Calf Lymph.	Benjamin Browning.
Burdett, H. C., Cottage Hospitals.	H. C. Burdett, F.S.S.
Burdett, H. C., Pay Hospitals of the World.	H. C. Burdett, F.S.S.
Christie, J., Dr., Epidemics in East Africa.	J. Christie, M.D.
Embleton, Dr. Dennis, Vivisection and Anti-Vivisection.	Dennis Embleton, M.D.
Fowler, Dr., Medical Vocabulary	Purchased.
Gerhard, W. Paul, House Drainage and Sanitary Plumbing.	W. Paul Gerhard.
Hodson, George, A Report to the Ratepayers of Loughborough on the Economical and Engineering Aspects of the Wood Brook and Black Brook Schemes.	George Hodson.
Jolly, Charles, Note sur l'Horticulture en Italie.	Charles Jolly.
Jolly, Charles, Note sur la Conservation et la Dessication des fruits.	Charles Jolly.
Knight's Annotated Model Bye-Laws.	Knight & Co.
Lambeth, Parish of, 26th Annual Report.	J. Baxter.

Larrey, M. le Barron, Discours Prononcé par M. le Barron Larrey Siane du 14th Juin, 1880.	M. le Barron Larrey.
M'Leod, K., M.D., Report on the Operations of the Sanitary Department of Glasgow carried out within the Five Years ended 30th April, 1882.	K. M'Leod, M.D.
Parodi, Il Signor C., L'Igiene nella Costruzione degli Ospitali.	Il Signor C. Parodi.
Parodi, Il Signor C., Nuovo Ospedale di S. Andrea in Genova.	Il Signor C. Parodi.
Physicians, Royal College of, List of Members.	Dr. H. A. Pitman.
PERIODICALS:—	
British Architect and Northern Engineer.	The Editor.
Journal d'Hygiene (weekly).	Dr. Prosper de Pietra Santa.
Journal für Gesundheitspflege.	M. Auspitz.
Journal of Medicine and Dosimetric Therapeutics (monthly).	Dr. F. L. Phipson.
Land (weekly).	The Editor.
L'Hygiene Pratique (weekly).	The Editor.
Lisboa, Boletim Hebdomadario de Estatistica Demographica e Medica.	The Editor.
Local Government Chronicle (weekly).	The Editor.
Sanitary Engineer, New York (weekly).	The Editor.
Sanitary Record (monthly).	The Editor.
Sanitary Journal (Monthly, Glasgow).	Dr. J. Christie.
Society of Arts Journal (weekly).	Society of Arts.

Report of the Commissioners appointed to enquire respecting Small-pox and Fever Hospitals, with Minutes of Appendix and Evidence.	Dr. A. Carpenter.
Sheffield, Report on the Sewerage of the Borough of.	Town Clerk, Sheffield.
Smith, S. E. L., The Possibility of Old Age.	S. E. L. Smith.
Sormani, Emilio Bignami, I Servizi Tecnici del Municipio di Milano.	Emilio Bignami Sormani.
Usill, G. W., Statistics of the Water Supply of the Principal Cities and Towns in Great Britain and Ireland.	Purchased.
Waring, Col. G. E., C.E., Report of the Board of Sewer Commissioners of the City of Buffalo, U.S.A., 1882.	Col. G. E. Waring.

HONORARY FOREIGN ASSOCIATES.

Prof. Ludovic Brunetti, Padua.

Dr. Ladreit de la Charrière, Mèdecin-en-Chef des Sourds-muets, 1, Rue Bonaparte, Paris.

A. Durand Claye, Ingénieur des Ponts et Chaussées, 69, Rue de Clichy, Paris.

Marié-Davy, President Société Français d'Hygiène a l'Observatoire de Moutsouris.

Dr. P. L. Durant, Professeur d'Hygiène, Geneva.

P. Duverney, 8, Place l'Anvers, Paris.

Luigi Gabba, Milan.

Dr. Galezowski, 29, Boulevard Haussman, Paris.

J. C. Jäger, Heerengracht, Amsterdam.

Alphonse Joltrain, Séc. de la Société Française d'Hygiène, 49, Avenue Wogram, Paris.

Barron Larrey, 91, Rue de Lille, Paris.

Dr. Malachia de Crestoforis, Milan.

Moutard Martin, 9, Rue de l'Echelle, Paris.

Mariani, 41, Boulevard Haussman, Paris.

Emilé Muller, 19, Rue des Martyrs, Paris.

Prof. Giacento Pacchiotti, Turin.

Dr. Passant, 39, Rue de Grenelle, St. Germain, Paris.

Prof. Dr. Jaetanus Peni, Milan.

Dr. C. Ricord, 6, Rue de Bournon, Paris.

Henry Roger, Président de l'Association des Médecins de France, 17 Boulevard de la Madeleine, Paris.

Prof. Dr. Georgio Roster, All'Instituto, Florence.

Dr. Charles Saffray, Sécrétaire de la Société Française d'Hygiène, 19, Rue Gerande, Paris.

Dr. Prosper De Piétra Santa, Redacteur, en Chef du Journal d'Hygiène, 79, Boulevard de Courselles, Paris.

C. Sarodi, Ingegnere, Genoa.

Luigi Del Sarto, Direttor dell'Uffizio d'Arte Municipale, Florence.

Cavaliere Emilio Bignami Sormani, 18, Via del Pesse, Milan.

Léon Temple, Montpellier.

M. Tréhyon, 71, Rue St. Anne, Paris.

Prof. Commendatore Salvatore Tommasi, Senatore, Reguo d'Italia All'Università di Napoli, Italia.

Prof. Cavaliere Marino Turchi, All'Università di Napoli, Italia.

FELLOWS.

Date of Election.

1881. Dec. ADAMS, G. E. D'Arcy, M.D., S.SC., CERT. CAMB., 1, *Clifton Gardens, Maida Vale, W.*

1880. May. AITKEN, PROF. William, M.D., F.R.S., *Woolston, near Southampton.*

1880. Dec. ANGELL, Lewis, M.INST.CE., *Town Hall, Stratford, E.*

1880. Dec. BARTLETT, GEN., J.P., *Exmouth, Devon.*

1878. Dec. BARTLETT, H. Critchett, PH.D., F.C.S., 39, *Duke Street, Grosvenor Square, W.*

1879. Jan. BASS, Hamar, M.P., *Burton-on-Trent.*

1878. Dec. BELL, C. W., J.P., D.L., *Bramblehurst, East Grinstead, Sussex.*

1878. Dec. BRABAZON, RT, HON. LORD, 83, *Lancaster Gate, Hyde Park.*

1880. Jan. BRAYE, RT. HON. LORD, 40, *Grosvenor Street, London' and Stanford Sard, Rugby.*

1878. Dec. BRIGHTEN, W. G., 4, *Bishopsgate Street Without, E.C.*

1881. Nov. BROWNING, Benjamin, L.R.C.P., M.R.C.S., F.C.S., S.SC., CERT. CAMB., 70, *Union Road, Rotherhithe.*

1878. Dec. BURBERY, J. Stone, *Beatrice Villa, Lorn Road, Southsea, Hants.*

1878. Dec. BURDETT, Henry C., F.S.S., 39, *Gloucester Road, Regent's Park, N.W.*

1882. Feb. BURGESS, Peter, M.A., M.B., *Commercial Bank of Scotland, Wishaw, Lanarkshire, N.B.*

1878. Dec. CAREW, R. R., *Carpenders, Watford, Herts.*

1880. Feb. CARPENTER, Alfred, M.D. LOND., M.R.C.S., S.SC. CERT. CAMB., *Duppas House, Croydon.*

1878. Dec. CARTER, R. Brudenell, F.R.C.S., 69, *Wimpole Street, Cavendish Square, W.*

1878. Dec. CHADWICK, Edwin, C.B., *Park Cottage, East Sheen, Mortlake, S.W.*

1880. July. CHILDS, CAPT. James, *The Terrace, Clapham Common.*

1878. Dec. CLARK, Daniel, *Carlisle.*

1881. July. Coles, William R. E., 44, *Berners Street, Oxford Street, W.*

1880. Dec. Collins, H. H., F.R.I.B.A., 5, *Randolph Road, W.*

1878. Dec. Colman, J. J., M.P., *Carrow House, Norwich.*

1878. Dec. Corfield, prof. W. H., M.A., M.D. OXON., F.R.C.P. LOND., 10, *Bolton Row, Mayfair, W.*

1881. May. Davey, Alexander George, M.D., L.R.C.P., M.R.C.S., 9, *Belvedere Street, Ryde, Isle of Wight.*

1878. Dec. de Chaumont, prof. F. S. B. F., M.D., F.R.S., *Woolston Lawn, Southampton.*

1878. Dec. Denison, A., 6, *Albermarle Street, W.*

1883. Jan. Derby. rt. hon. earl of, P C., 23, *St. James' Square, London, S. W.*

1878. Dec. Doulton, Henry, *Lambeth.*

1878. Dec. Drewry, G. Overend, M.D.

1878. Dec. Dyke, T. J., F.R.C.S., *The Hollies, Merthyr Tydfil.*

1878. Dec. Eassie, William, C.E., F.L.S., F.G.S., 11, *Argyll Street, Regent Street, W.*

1881. Oct. Eaton, John, M.D., *Orchard House, Cleator Moor, Cumberland.*

1880. Apr. Ellis, W. Horton, F.M.S., *Hartwell House, Exeter.*

1878. Dec. Evans, T. W., *Allestree Hall, Derby.*

1878. Dec. Field, Rogers, B.A., M.INST.C.E., 5, *Cannon Row, Westminster, S. W.*

1879. Jan. Fortescue, rt. hon. earl, 20, *Charles Street, Berkeley Square, London; and Castle Hill, South Molton, Devon.*

1878. Dec. Galton, capt. Douglas, R.E., C.B., D.C.L., F.R.S., 12, *Chester Street, Grosvenor Place, S. W.*

1878. Dec. Gilchrist, J., M.D., *Crichton House, Dumfries.*

1880. July. Grantham, R. B., M.INST.C.E., 22, *Whitehall Place, London, S. W.*

1878. Dec. Griffiths, E. F. G., ASSOC.M.INST.C.E., *Abingdon Street, S. W.*

1880. Jan. Grimshaw, Thomas Wrigley, M.D., *Priorsland. Carrickmines, Dublin.*

1878. Dec. Harker, J., M.D., *King Street, Lancaster.*

1881. May. Harris, Thomas, F.R.I.B.A., 20, *High Holborn, W.C.*

1879. Feb. Haviland, A., M.R.C.S.

1880. Apr. Hime, Thomas Whiteside, A.B., M.B., L.R.C.S., 217, *Glossop Road, Sheffield.*

1881. May. Hodgson, George, assoc.m.inst.c.e., *Town Hall, Loughborough.*

1878. Dec. Howard, James, *Clapham Park, Bedfordshire.*

1878. Dec. Jones, lieut.-col., v.c., assoc.m.inst.c.e., *Hafod-y-wern Farm, Wrexham.*

1878. Dec. Leaf, Charles J., f.l.s., f.s.a., *Pain's Hill, Cobham, Surrey.*

1878. Dec. Leaf, W., *Pain's Hill, Cobham, Surrey.*

1883. Jan. Lewis, prof. T. Hayter, f.s.a., f.r.i.b.a., 12, *Kensington Garden Square.*

1878. Dec. Livesey, J., m.inst.c.e., 9, *Victoria Chambers, Westminster, S.W.*

1878. Dec. Longstaff, G. B., m.b., m.a., cert. prev. med., *Southfield Grange, Wandsworth, S.W.*

1878. Dec. Lubbock, sir John, bart., d.c.l., f.r.s., *Lombard Street, E.C.*

1878. Dec. Mackey, John Alexander Dixie, *Christ Church, Oxford.*

1878. Dec. Marsh, Lory, m.d., *Greenhithe, Kent.*

1878. Dec. Mason, J,, j.p., *Lynsham Hall, Witney, Oxford.*

1878. Dec. Molyneux, hon. Francis G., *Earl's Court, Tunbridge Wells.*

1880. Dec. Northcote, rt. hon. sir Stafford, *Carlton Club, and Pynes House, Exeter.*

1878. Dec. Northumberland, his grace the duke of, d.c.l., ll.d., 2, *Grosvenor Place, S.W.*

1878. Dec. Ohren, Magnus, assoc. m.inst. c.e., f.c.s., *Lower Sydenham.*

1878. Dec. Ollard, J. F., *Lloyds, E.C.*

1878. Dec. Ollard, William Ludlam, *Musticott House, Walsoken, Wisbeach.*

1878. Dec. Paget, J., j.p., *Stuffynwood, Mansfield.*

1880. Dec. Peggs, J. Wallace, assoc.m.inst.c.e., 21, *Queen Anne's Gate, S.W.*

1878. Dec. Richardson, Benjamin Ward, m.d., ll.d., f.r.s., 25, *Manchester Square, W.*

1878. Dec. Richardson, J., m.inst.c.e., *Methley Park, Leeds.*

1881. Jan. Robbins, W. Morgan, 107, *High Street, Ilfracombe.*

1881. Oct. Robins, Edward Cooksworthy, f.s.a., f.r.i.b.a., 14, *John Street, Adelphi.*

1882. May. Robinson, Henry, prof. m.inst.c.e., 7, *Westminster Chambers, S.W.*

1878. Dec. Russell, hon. F. A. Rollo, *Pembroke Lodge, Richmond Park.*

1878. Dec. Russell, James A., M.A., M.B., B.SC., *Canaan Lane, Woodville, Edinburgh.*

1878. Dec. Salt, Thomas, M.P., 85, *St. George's Square, S.W.*

1878. Dec. Scott, maj.-gen. H. Y. D. Scott, R.E.., C.B., F.R.S., *Ealing.*

1881. Nov. Smith, William Robert, M.D., F.R.S.E., F.C.S., S.SC. CERT. CAMB., 15, *Imperial Square, Cheltenham.*

1880. Jan. Snell, H. Saxon, F.R.I.B.A., 22, *Southampton Buildings, W.C.*

1878. Dec. Stephens, Henry C., F.C.S., *Avenue House, Finchley.*

1879. July. Symons, G. J., F.R.S., 62, *Camden Square, N.W.*

1880. Dec. Temple, right rev. Frederick, D.D., lord bishop of exeter, *The Palace, Exeter.*

1880. June. Thompson, John, M.D., F.R.C.S., J.P., *Lynton House, Bideford.*

1878. Dec. Turbervill, col. T. Picton, *Ewenny Priory, Bridgend, Glamorgan.*

1878. Dec. Turner, Ernest, F.R.I.B.A., 246, *Regent Street, W.*

1879. Aug. Ure, J., lord provost of glasgow, *Helensburgh, N.B.*

1881. June. Varley, Cromwell F., F.R.S., M.INST.C.E., *Cromwell House, Bexley Heath.*

1880. Dec. Waring, col. G. E., Jun., C.E., *Newport, Rhode Island, U. S. America.*

1882. Feb. Whitelegge, Benjamin Arthur, B. SC., M.D., S.SC.CERT. CAM., *Knutsford, Cheshire.*

1879. Jan. Wilson, George, M.A., M.D., 23, *Claremont Road, Leamington.*

1878. Dec. Wyatt-Edgell, rev. E., B.A., 40, *Grosvenor Street, W.*

MEMBERS.

* Life Members. † Passed examination for Local Surveyor.
‡ Passed examination for Inspectors of Nuisances.

1879. Dec. Addis, William Judson, C.E., M.S.A., R.A.S., *Prome, British Burmah.*

1882. July. Alcock, Samuel, *Sunderland.*

1877. Mar. Allen, Henry Robert, *North Street, Hackney, E.*

1882. Oct. ANDERSON, Alexander McGlashan, M.D., L.R.C.S., 26, *South Tay Street, Dundee.*

1882. July. ANDREW, CAPT. C. W., 286, *Kennington Park Road, S.E.*

1876. July. ANNINGSON, Bushell, M.A., M.D., *Cambridge.*

1876. July. ATKINS, F. H., 62, *Fleet Street, E.C.*

1878. July. ATWOOL, J., *Sydney Lodge, Farncombe Road, Worthing.*

1878. July. BAKER, R., *Ballingdon House, Green Lanes, N.*

1876. .... BALL, F., 18, *Bell Street, Henley-on-Thames.*

1878. Jan. BANNER, E. G., 11, *Billiter Square, E.C.*

1876. July. BARBER, Samuel J., *Eastwood, Notts.*

1877. .... BARROW, B., F.R.C.S., J.P., *Southlands, Ryde, Isle of Wight.*

1879. Dec. BARR, William Alexander, M.D., M.R.C.S., 45, *Abington Street, Northampton.*

1877. July. BARRY, J. G., 87, *Cannon Street, E.C.*

1882. Jan. BARTLETT, Robert V. O., 1, *St. John's Place, Newport, Isle of Wight, and Brixton, S.W.*

1878. Oct. BAUGH, Alfred Charles, C.E., 3, *Temple Row, Wrexham.*

1877. .... BEARD, Neville, *The Mount, Ashbourne.*

1876. July. BELL, Thomas, L.R.C.P. LOND., *Uppingham, Rutland.*

1878. Oct. BEMROSE, Henry H., *Lonsdale Hill, Uttoxeter Road, Derby.*

1877. .... BENNET, J. Henry, M.D., *The Ferns, Weybridge.*

1877. July. BENNETT, Hugh, M.R.C.S., *Builth Wells, Brecon.*

1876. July. BERESFORD, Robert, M.D., *Oswestry, Salop.*

1877. Aug. BERRINGTON, R. E. W., 10, *Bank Square, Chepstow.*

1876. July. BEST, Frederick A., M.R.C.S., *Church Hill, Walthamstow.*

1878. July. BICKERSTETH, E. R., F.R.C.S., 2, *Rodney Street, Liverpool.*

1878. Oct. BINDLEY, CAPT., *Burton-on-Trent.*

1881. June. BINDON, William J. Vereker, D.SC. PUB. HEALTH EDIN., M.D., *Appins, West End Lane, Hampstead.*

1878. Sept. BIRCH, R. W. Peregrine, M.INST.C.E., 2, *Westminster Chambers, S.W.*

1877. Sept. BIRD, Peter Hinckes, F.R.C.S., S.SC. CERT. CAMB., 1, *Norfolk Square, W.*

1881. Nov. *BOND, Frederick Adolphus, M.B., C.M. EDIN., S.SC. CERT. EDIN., *Brinklow, Coventry.*

1877. .... BOSTEL, D. T., 19, *Duke Street, Brighton.*

1878. Oct. BOSTOCK, H., *The Oaklands, Rowley Avenue, Stafford.*

1880. Nov. †*Boulnois, H. Percy, m.inst.c.e., 2, *Mount Radford Crescent, Exeter.*
1877. Oct. Bower, Thomas, *Lytham, Lancashire.*
1876. July. Brett, A. T., m.d., *Watford House, Herts.*
1881. Jan. Brooks, James, f.r.i.b.a., 35, *Wellington Street, Strand.*
1876. July. Brown, P., m.d., *Blaydon House, Blaydon-on-Tyne.*
1876. .... Burns, R. Scott, c.e., *Oak Lea, Edgeley Road, Stockport.*
1876. Aug. Burney, G., *Millwall Docks, E.*
1880. Dec. †*Burton, W. Kinninmond, 1, *Adam Street, Adelphi, W.C.*
1878. Oct. Butler, G. J., *Shrewsbury.*
1876. Aug. Carline, John, assoc.m.inst.c.e., *Lewisham Board of Works, S.E.*
1882. Jan. Carritt, Ernest, 4, *Lime Street Square, E.C.*
1876. July. Carter, W. Allan, 5, *St. Andrew's Square, Edinburgh.*
1878. Oct. Champion, A. J., 6, *Westminster Chambers.*
1881. May. Cheston, Horace, a.r.i.b.a., 1, *Great Winchester Street, London, E.C.*
1883. Feb. Christie, James, a.m., m.d., 2, *Great Kelvin Terrace, Hillhead, Glasgow.*
1880. Jan. Collingridge, W., m.r.c.s., m.a., m.b., s.sc. cert. camb., *Port of London Sanitary Offices, Greenwich.*
1878. Sept. Collins, Sir W., 3, *Park Terrace, East Glasgow.*
1876. .... Collins, W. J., m.d., 1, *Albert Terrace, N.W.*
1882. Nov. †*Cooper, C. H., *Local Board Offices, Wimbledon.*
1878. Sept. Corbett, J., 24, *Barton Arcade, Manchester.*
1877. .... Crookes, W., f.r.s., 7, *Kensington Park Gardens, W.*
1877. Sept. Crowley, Frederick Ashdell, *Alton, Hants.*
1877. Oct. ‡Davies, Hugh, 1, *Hill Street, Wrexham.*
1881. Oct. Day, Ernest, 5, *Foregate Street, Worcester.*
1878. Sept. Delahunty, James, *Waterford.*
1878. May. Dennis, W., m.inst.c.e., 3, *Victoria Street, Westminster.*
1877. July. Dodd, J., 6, *Thomas Street, Liverpool.*
1878. Oct. Douglas, George, *Burslem.*
1877. .... Doulton, James D., *Lambeth, S.W.*
1876. Dec. Dowson, A., assoc.m.inst.c.e., 3, *Great Queen Street, Westminster, S.W.*
1877. Aug. Dyer, F., 66, *High Street, Camden Town, N.W.*
1877. Aug. Ebury, rt. hon. lord, p. c., *Moor Park, Rickmansworth.*
1882. Oct. Ellison, Ralph Carr, j.p., *Dunster Hill, Gateshead-on-Tyne.*

1882. Oct. Embleton, Dennis, M.D., F.R.C.P., 4, *Eldon Square, Newcastle-on-Tyne.*

1881. Dec. Farr, Archer, L.R.C.P. EDIN., S.SC. CERT. EDIN., 37, *Queen Street, E.C., and* 370, *Coldharbour Lane, Loughboro' Park, S.W.*

1878. June. Forshaw, Edward, *Bank Chambers, Hanley.*

1879. Dec. *Foster, Reginald Le Neve, F.C.S., *North Road, Droylsdon, Manchester.*

1878. July. Fry, Miss C. A., *St. Catherine's, Oxford.*

1878. .... Gentles, Thomas Lawrie, L.F.P.S. GLASG., *Wellington House, Derby.*

1878. June. Gill, D., *Farleigh, Weston-super-Mare.*

1878. Oct. Griffiths, Robert, *County Surveyor, Stafford.*

1878. July. Griffiths, Thomas, *Silverdale, Oxton, Birkenhead.*

1878. Mar. Griggs, R., 11, *Gray's Inn Square, W.C.*

1877. Aug. Hamilton, Sir, R. N. C., K.C.B., *Avon Cliffe, Stratford-on-Avon.*

1881. June. Hammond, Frederick, 2, *Coleman Street Buildings, Moorgate Street, E.C.*

1876. July. Harker, the Rev. W.

1880. Nov.‡†*Harland, A., 170, *Stanhope Street, N.W.*

1882. June. Harris, Alfred E., L.R.C.S., L.R.C.P., *M.O.H.*, 14, *The Avenue, Sunderland.*

1877. Sept. Harrison, C., M.D., S.SC. CERT. CAMB., *Newland, Lincoln.*

1882. June. Harrisson, Thomas Harnett, ASSOC.M.INST.C.E., 21, *Harrington Street, Liverpool.*

1876. July. Hartley, R., L.R.C.P. EDIN., *Pemberton, Wigan, Lancashire.*

1878. May. Holt, H. P., ASSOC.M.INST.C.E., F.G.S., *Fairlea, Palatine Road, Didsbury, Manchester, and* 5 *Westminster Chambers, S.W.*

1878. July. Hooker, J., F.C.S., 104, *Upper Thames Street, E.C.*

1877. July. Hooper, Rev. R. P., M.A., F.R.G.S., 31, *Cambridge Road, Hove, Brighton.*

1877. Mar. Howard, E., 84, *Upper Whitecross Street, E.C.*

1882. June.†*Hubber, Frank, *George Street, Exeter.*

1878. Mar. Humphrey, Prof. G. M., M.D., F.R.S., *Cambridge.*

1878. June. Husband, H. Aubrey, M.R.C.S., 27, *Chalmers Street, Edinburgh.*

1878. Sept. Hyde, Samuel, M.R.C.S., *Clifford Lodge, Buxton.*

1877. June. Iliffe, W., M.R.C.S., *Hartington Street, Derby.*

1878. Sept. INGILBY, SIR Henry D., BART., 9, *Hereford Gardens, Park Lane, W.*

1882. July. JONES, John Watkin, *Maesyffynon, Tonalaw, near Ponty-pridd, South Wales.*

1877. .... LAKE, W. C., M.D., *Teignmouth, Devon.*

1876. July. LATHAM, Baldwin, M.INST.C.E., F.M.S., F.G.S., 7, *Westminster Chambers, S.W.*

1878. May. LAW, Henry, M.INST.C.E., 5, *Queen Anne's Gate, S.W.*

1877. .... LAWS, J., *Blyth, Northumberland.*

1878. July. LAWSON, R., *Lansdowne Road, Notting Hill.*

1877. Oct. LAYTON, Thomas, *Kew Bridge, Middlesex.*

1878. Oct. LEE, John, *Church Street, Ashbourne.*

1876. July. LE GRAND, A., 100, *Bunhill Row, E.C.*

1878. Oct. LEMON, James, M.INST.C.E., F.R.I.B.A., *Lansdowne House, Southampton.*

1877. ... LEON, George I., 1, *First Avenue, Hove, Brighton.*

1881. Dec. LEONARD, Hugh, 7, *Hanover Square, W.*

1880. Dec. *LINGARD, J. Edward, ASSOC.M.INST.C.E., *Rodney Chambers, Derby.*

1877. July. LLOYD, Thomas, *The Square, Winchester.*

1882. Apr. LYTE, F. Maxwell, F.C.S., F.I.C., *Union Club, Trafalgar Square.*

1878. July. MCARTHUR, A., M.P., *Raleigh Hall, Brixton Rise.*

1882. Oct. MCCARTHY, J. Desmond, M.D., F.C.S., F.R.G.S., *Darlington; and Largos, West Africa.*

1879. July. MACFARLANE, Walter, *Saracen Foundry, and* 22, *Park Circus, Glasgow.*

1878. Nov. MACKEY, John B., 2, *Bouverie Street, Fleet Street, E.C.*

1878. Oct. MACLAGAN, James McGrigor, M.D., *Riding-Mill-on-Tyne, Northumberland.*

1878. May. MANSERGH, James, M.INST.C.E., 3, *Westminster Chambers, Victoria Street, S.W.*

1878. Oct. MARTEN, H. J., M.INST.C.E., *The Birches, Codsall. Wolverhampton.*

1878. Sept. MARTIN, J. M., C.E., *Castle Chambers, Exeter.*

1878. Sept. MASON, Hugh H., M.R.C.S., *Abbey Lodge, Barking.*

1876. .... MEGGET, A., 7, *Huntris Row, Scarborough.*

1878. .... MEIKLEJOHN, J., *Dalkeith, N.B.*

1877. Oct. MELISSENOS, G. C. A., Melisurgo, ASSOC.M.INST.C.E., *Palazzo Cocozzo,* 76, *Via Pocrio, Naples.*

1878. Sept. Miller, John Faure, M.D., 28, *Rue de Matignon, Faubourg St. Honoré, Paris.*

1873. June. Moore, J. H., *St. Michael's Lodge, Bournemouth.*

1883. Jan. Morcom, Augustus, L.R.C.S., *Montpelier House, Dunstable, Beds.*

1879. Feb. *Moseley, George, F.R.C.S., *Breadalbane Lodge, Spencer Road, Eastbourne.*

1882. Oct. *Mynors, Walter Charles Towers, *Little Ingestre, Stafford.*

1882. Apr. Nanson, Thomas, 9, *Park Crescent, Stockwell Park Road, S.E.*

1877. Sept. Nelson, E. M., *Hanger Hill House, Ealing.*

1877. Sept. Nelson, George H., *The Lawn, Warwick.*

1878. Sept. Nichols, G. B., C.E., *Handsworth, Birmingham.*

1876. July. Nixon, Charles J., *Addiscombe, Cranborne Road, Bournemouth.*

1878. May. Norman, W. S., 13, *Warwick Road, W.*

1882. Nov. Nuttall, John Henry, ASSOC.M.INST.C.E., *Fernsholme, Bury, Lancashire.*

1877. Sept. Ogle, William, M.A., M.D., F.R.C.P., *Somerset House, London, W.C.*

1881. Mar. * Page, Herbert Markant, M.D., S.SC. CERT. CAMB., M.R.C.S., 16, *Prospect Hill, Redditch.*

1877. .... Pagliardini, T., 75, *Upper Berkeley Street, Portman Square, W.*

1878. May. Parker, J., *Woodstock.*

1877. .... Parker, W. C., M.INST.C.E., *Whitehall Club, S.W.*

1878. .... Pattinson, S., *Ruskington, Sleaford, Lincoln.*

1877. June. Peel, Edmund, *Brynfys Ruabon, North Wales.*

1882. Jan. Perry, Henry Robert, A.R.I.B.A., *Oak Cottage, Western Bank, Derby.*

1881. June. Perry, John Tavenor, A.R.I.B.A., 9, *John Street, Adelphi.*

1883. Mar. Plumbe, Rowland, F.R.I.B.A., 13, *Fitzroy Square, W.*

1879. Dec. *Powell, George Thompson, *Rotherwood, Sydenham Hill, and* 11, *Pancras Lane, E.C.*

1877. .... *Powell, J., 10, *St. George's Crescent, Liverpool.*

1878. June. Pritchard, E., C.E., F.G.S., 27, *Great George Street, Westminster, S.W.*

1877. .... Pritchett, G. E., F.S.A., 20, *Spring Gardens, S.W., and Oak Hall, Bishop's Stortford.*

1877. Aug. Pullin, T. H. S., M.D., *Sidmouth.*

1877. Sept. Rae, Robert, 337, *Strand, W.C.*

1881. Jan. RAINGER, Charles Henry, 9, *Bath Place, Cheltenham.*
1876. July. REDWOOD, T. Hall, M.D., *The Lawn, Rhymney.*
1881. June. REED, Frederick H., A.R.I.B.A., 10, *Belmont Hill, Lee, S.E.*
1878. Oct. RICHARDS, E. M., ASSOC.M.INST.C.E., *Town Hall, Leamington.*
1878. Oct. RUSSELL, J. B., M.D., *Medical Officer of Health, Glasgow.*
1878. July. SANDYS, MAJOR M., 87, *Jermyn Street, S.W.*
1881. July. SCHMIDT, E. W. C. F., A.R.I.B.A., *Eastbourne, Sussex.*
1876. Oct. SHAFTESBURY, RT. HON. EARL OF, K.G., 24, *Grosvenor Square, W.*
1876. July. SHONE, Isaac, ASSOC.M.INST.C.E., *Wrexham.*
1878. Oct. SHRIMPTON, Charles, M.D. PARIS, 11, *Willswood Park, Torquay.*
1877. .... SILLAR, W. C., *St. James' Lodge, Kidbrooke Park Road, Blackheath, S.E.*
1882. Nov. SIMPSON, William John, M.D., S.SC.CERT.CAMB., 110, *Crown Street, Aberdeen.*
1878. Nov. SKRINE, Henry Duncan, *Claverton Manor, Bath.*
1877. .... SLADE-KING, Edwyn, M.D., LIC. IN STATE MED., R.C.P. EDIN., *Croft Side, Ilfracombe.*
1883. Mar. SLATER, John, B.A., 14, *Bedford Row, W.C.*
1877. June. SMITH, R. W., *Mount Rundell Harborne, Birmingham.*
1877. May. SMITH, W. R., *Clifton House, Clifton-by-Ashbourne, Derbyshire.*
1878. Oct. SPRUCE, Samuel, *Beech House, Tamworth.*
1878. July. STAINTHORPE, W. Waters, M.D., S.SC. CERT. EDIN., *Kirkleatham, Redcar.*
1876. July. STIFF, E., *London Pottery, Lambeth.*
1876. July. SUTCLIFFE, R., 100, *Bunhill Row, E.C.*
1877. Sept. SWETE, Horace, M.D., S.SC. CERT. CAMB., F.C.S., *The Grove, Worcester.*
1880. Jan. *SYKES, J. F. J., B.SC. PUB. HEALTH, M.B., L.R.C.P., M.R.C.S., 7, *Thayer Street, Manchester Square.*
1876. Oct. TAYLOR, John W., M.D., D.SC., *Rothsay House, Scarboro'.*
1881. Nov. TAYLOR, Shepherd T., M.B. LOND., L.R.C.P., M.R.C.S., *Grove House, Norwich.*
1877. .... TEMPLETOWN, GEN. RIGHT HON. VISCOUNT, K.C.B., 49, *Charles Street, Berkeley Square.*
1878. July. THOMAS, W. Cave, 53, *Welbeck Street, W.*
1878. .... THORNLEY, J. E. Lyndon, *Bickenhill near Birmingham.*
1878. Oct. TROTTER, Arthur E. H., *Stockton-on-Tees.*

1879. July. Tylor, William Alfred, 2, *Newgate Street, E.C.*

1882. July. Vigers, Edward, A.R.I.B.A., F.S.I., 38, *Parliament Street, S.W., and 79, Elgin Road, Paddington.*

1877. June. Walker, J. H., L.R.C.P. EDIN., *Pickering, Yorkshire.*

1877. Sept. Waller, Thomas, 47, *Fish Street Hill, E.C.*

1881. May. Webb, Phillip, 1, *Raymond Buildings, Gray's Inn, W.C.*

1878. Oct. Welford, J., 4, *Warwick Place, Paddington, W.*

1880. May. White, William, F.S.A., F.R.I.B.A., 30A, *Wimpole St., W.*

1877. Sept. Whitwill, Mark, *Redland House, Durdham Park, Bristol.*

1878. July. ‡Wilkinson, William, *Town Hall, Salford.*

1881. July. *Withers, J. B. Mitchell, F.R.I.B.A., 5, *Surrey Street, Sheffield.*

1882. July.‡†*Witts, J. W., *Market Harborough.*

1877. Sept. Wood, Jacob, M.P.S., 186, *Highbury Park, N.*

1882. Jan. Worsnop, Frederick, 48, *Westfield Road, Burley Road, Leeds.*

1878. Sept. *Yuill, W., ASSOC.M.INST.C.E., 3, *Fenchurch Avenue, E.C.*

ASSOCIATES.

* Life Associates. ‡ Passed Examination for Inspectors of Nuisances.

1881. May. Bamlett, Adam Carlisle, *Thirsk, Yorkshire.*

1882. June.‡*Baxter, John, 2, *Walnut Tree Walk, Kennington Road, S.E.*

1879. Dec. *Blake, Edward Thomas, M.D., 47, *Seymour Street, Hyde Park, W.*

1879. Aug. Bolding, John T., 19, *South Moulton Street, W.*

1879. Nov. ‡*Clarke, A. Lennox, *Union Buildings, Selly Oak, King's Norton.*

1882. Mar. Densham, Charles A., 55, *Cochrane Street, St. John's Wood.*

1880. Feb. Emptage, Daniel, *Dane Hill Sanitary Works, Margate.*

1882. Oct. Goddard, Frederick K., *Newcastle-on-Tyne.*

1881. Nov. ‡*Horrocks, Joseph, *Chicago.*

1882. Feb. KENNINGTON, Thomas, 47, *Colmore Row, Birmingham.*

1880. Feb. KINSEY, W. Barns, *Hop Exchange, Southwark, S.E.*

1879. Nov. ‡*LAPWORTH, J., *Vestry Hall, Bethnal Green, E.*

1882. July. ‡*LIGHTFOOT, Thomas, 3, *Trevor Square, Knightsbridge.*

1881. Nov. ‡*RAINS, Joseph, *Kettering.*

1882. Nov. ‡*RICHARDS, Daniel, 3, *Spencer Street, Park Road, Battersea.*

1881. Nov. ‡*SORTWELL, W., 9, *Retreat Place, Paragon Road, Hackney, E.*

1882. June. ‡*STEERS, George, *Wellington Street, Bedford.*

1883. Jan. WALLIS, Arthur Gay, 45, *Gough Road, Edgbaston.*

1883. Feb. WELCH, Henry, M.B., B.SC. EDINBURG, 4, *Queen Street, Lancaster.*

1881. June. †*WILKINSON, W., 48, *Canning Street, Bury.*

SUBSCRIBERS.

* Life Subscribers.

1879. Oct. ANGELL, A. Torrington, 144, *Fulham Road, S.W.*

1879. Oct. BATTEN, MAJ.-GEN. S. J., 14, *Notting Hill Square.*

1879. Sept. BOURNE, Stephen, *Atherley, Wallington, Surrey.*

1879. .... COBHAM, George R., *Gravesend.*

1879. June. COLES, Cowper, C.B., 95, *Wigmore Street, W.*

1879. Apr. DENHAM, W. Hempson, F.L.S., F.S.S., *Southsea.*

1881. Jan. DIXON, Joshua, *Winslade, Exeter.*

1880. .... DOMENICHETTI, Richard, M.D., *Trinity Lodge, Louth. Lincolnshire.*

1877. Sept. FLEETWOOD, The Local Board of.

1879. Mar. GOODALL, Abraham, F.R.C.S., F.R.G.S., INSP.-GENL., 4, *Elvaston Place, Queen's Gate.*

1879. June. HALL, Alexander Lyons, F.R.G.S., *Lyons Court, Ladbroke Road, W., and Lyons Court, co. Antrim, Ireland.*

1879. Oct. JENNKINS, B., 37, *Outram Road, Croydon.*

1879. Sept. JEWEL, J.

1877. .... LADIES SANITARY ASSOCIATION, 22, *Berners Street, Oxford Street, W.*

1879. .... Middleton, Reginald E., assoc.m.inst.c.e., 5, *Westminster Chambers, S.W.*

1879. Sept. *Pratt, M., *Brigstock House, Thornton Heath, Croydon.*

1877. .... Rivers Purification Association, 232, *Gresham House, E.C.*

1878. Oct. Southport, The Mayor and Corporation of.

1880. .... Stephenson, F. C., *Hill House, Little Heath, Charlton, S.E.*

1877. Sept. Tottenham Sanitary Association, *High Cross, Tottenham.*

1879. Feb. Wallace, Miss, 6, *Hyde Park Gardens.*

GENERAL INDEX.

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