process of purification it undergoes, and the minute division in which it passes through a body of water varying from 3 to 4 ft. in depth to float on the surface, must, I think, place it, when compared by the ordinary methods of comparison with other blacks, in a high class as regards purity, minuteness of division, and hence lightness, freedom from grit or cinder, hence facility and thoroughness of mixing, and intensity and deepness of color.

The cinder, as collected from the "tranquil bed," when thoroughly dried, has also a marketable though inferior value, as it is only applicable for the coarser kinds of black paint. I would close by adding that it seems certainly a new and favorable point from which to view "London soot," viz., as containing a substance capable of forming the basis of a black pigment superior to that of any similarly-prepared pigment in the market and a carbon of great purity—all to be done automatically, without further expense, trouble, or interruption, and thus possibly to prove, as in the case of the refuse of gas coal, "a valuable residual."

LECTURE TO THE CONGRESS,

BY

CAPTAIN DOUGLAS GALTON, C.B., D.C.L., F.R.S., &c.

THE object of the Sanitary Institute in holding an Annual Congress is to endeavour to excite the interest of the community in sanitary knowledge; and I do not think that I can occupy your time more usefully this evening than by drawing your attention to one of the most valuable pieces of work which the Sanitary Institute performed last year, and which bears a special relation to the question of the prevention of disease, viz., the publication, under the auspices of the Sanitary Institute, of *Selections from the Reports and Writings of Dr. Farr, on Vital Statistics*, under the editorship of our eminent member, Mr. Noel Humphreys.

Dr. Farr laboured successfully, in forwarding the science of vital statistics, for little short of half a century. Indeed, I may say that in this country no one has rendered a greater service to this branch of sanitary investigation than Dr. Farr, and the pages of Mr. Humphreys' collation of Dr. Farr's work are so replete with interest that I trust that the account of some of his views on practical sanitation, which I shall be able to mention to-night, will be the means of inducing many of you to study them for yourselves.

The science of vital statistics lies at the foundation of all accuracy in sanitary research. The national registration of the causes of deaths, which has only been systematically carried on over the whole country since 1838, has given greater prominence to the principles of physic, and has enabled the science of medicine, like other natural sciences, to abandon vague conjecture for facts accurately determined by observation, and to substitute numerical expressions for uncertain assertions.

The registration of the causes of deaths necessarily leads on to further investigation.

For instance, it induces the study of the locality in which

the people live, its climate, its soil, its drainage, the density of its population, and the mode in which they are housed.

It induces inquiries into the wealth or poverty of the people, their means of obtaining food and clothing, into their occupations and social position, and the proportion of each class to the whole and to one another.

It leads to the consideration of the age-composition of the population, *i.e.*, the population living at each age, or ætal period, and, therefore, their expectation of life; and of the relations of births, marriages, and deaths to one another and to the population.

It further leads to enquiries into the causes of the diseases of which the people die.

Hence the study of vital statistics has been the means of inducing a great development of practical sanitation; it has brought prominently into notice the fact that the propagation of a certain class of diseases, from which large numbers of the population die, is favoured and assisted by preventible causes; and that if these causes favouring their propagation were removed and means were taken to check their spreading, the class of what has been termed preventible diseases might be expected to disappear.

It would only weary you if I were to attempt to give you a condensed summary of what this very interesting volume contains. I propose therefore to limit myself to directing your attention to one or two of the lessons which Dr. Farr has inculcated, which have a special bearing upon our future progress in sanitation, and which are more especially connected with the application of sanitary principles to practice. I will, however, in the first place, briefly allude to the method of which Dr. Farr makes use, to show in a definite form the pecuniary advantages which the community derive from healthy conditions, that is to say the economical value of sanitation.

Economical Value of Sanitation.

By the term economical value, I would wish to imply not only the large money value which a healthy population may be said to possess, as compared with an unhealthy population, by reason of its greater power of work and diminished outlay for defraying the cost incidental to disease, and to the support of the diseased and incapacitated members of the community, but also the much larger amount of individual happiness which the healthy population enjoys; and in this connection you will remember that at our meeting at Glasgow, Dr. Richardson gave us a most interesting lecture on Felicity as a sanitary research. He then shewed us that felicity stands precisely in

the same position as health; that in its widest sense it means health, and is another word for health.

In order to estimate the money value of life, we must bear in mind that in its production and education a certain amount of capital is sunk for a longer or shorter time; capital thus sunk, with its interest, as a general rule reappears in the wages of the labourer, the pay of the officer, and the income of the professional man. The labour of the parents, and the expense of attendance, nurture, clothing, lodging, education, apprenticeship, practice, are investments of capital, at risk, extending over many years, and the return appears in the form of the wages, salaries, or incomes, of the survivors.

The outgoings increase from infancy up to a certain age; the earnings then commence, and ere long equal the outgoings; the earnings continue subsequently in excess throughout manhood, but as life advances they decrease, until they are extinguished amidst the feebleness and infirmities of old age. The present value of the person's probable future earnings, minus the necessary outgoings in realizing those earnings, is the present value of that person's services. Like capital invested in the soil, in the vintage, or in a commercial adventure, the capital invested in the life of a man returns, in happy natures, profit of a hundred-fold; in other cases fifty, twenty, ten-fold; in others it is barely returned; in some it is entirely lost, either by death, sickness, vice, idleness, or misfortune.

At first it is all expenditure, and a certain necessary expenditure goes on to the end, to keep life in being, even when its economic results are negative.

The value of any class of lives is determined by valuing first at birth, or at any age, the cost of future maintenance, and then the value of the future earnings.

Proceeding on this method Dr. Farr estimates that for an agricultural labourer on good wages the present value of a child at birth is £5, at 5 years old £56, at 10 years old £117. The present value of a youth at 15 is £192. The present value of a young man at 20 is £234, and the man at 25 is £246. But after that age the prospective value decreases, and at 30 years of age it is £241, at 55 years of age it is £138, at 70 years of age it is £1.

The cost of maintenance afterwards exceeding the earnings the value becomes negative: at 80 the value of the cost of maintenance exceeds the value of the earnings by £41.

These values are borne out on a comparison made with the former cost of slaves in Rome, in the United States, and in the West Indies.

The amount of capital sunk in the education of professional men is not only much greater but it is probably at greater risk, and it has to remain longer under investment before it is returned. The maximum value of such a man is attained later in life, probably at 40 years of age, and in the highest orders of the Church, law, and politics, where experience and great weight of character are requisite, the life increases in value at still higher ages.

Thus, until the period of old age is reached, life has a definite money value, small in childhood, increasing to middle age, and then declining in old age.

This money value is, however, dependent on the health of the population. Dr. Farr gives an average, but the average in a healthy population would be very much higher than in an unhealthy one, in which the children were sickly, the youths stunted, and manhood weakened by early disease, and cut off in its prime.

It has been often said that the comparative health of different populations may be judged by the deaths of the children. This may be true as to the death-rate, but the deaths of children depend on many contingencies which would not necessarily affect the general health.

It would seem that in England nearly half of the deaths is made up of the young under ten years of age, and of these deaths by far the largest proportion is of children under one year of age.

The agencies which destroy infant life are many, and they vary in different localities. Some of the principal causes are improper and insufficient food, bad management, use of opiates, neglect, early marriages, and debility of mothers; but whatever may be the special agencies at work which are so prejudicial to infant life, it must be borne in mind that a high death-rate among children is also in a great measure due to bad sanitary arrangements.

About one-seventh of the population die of what Dr. Farr termed filth diseases, and probably five-sixths of the deaths from these diseases are of children under ten years of age.

As evidencing the influences of insanitary conditions on the death-rate of children, I may mention that I was reading a letter the other day from the Sanitary Commissioner with the Government of Bombay, who mentioned that in the town of Ahmedabad, in India, the general death-rate is permanently 53 per 1000 annually; and the children under one year die at the rate of 333 per 1000, or one out of every three born dies within the first year of life; and he stated that this is owing to the whole town being perforated with filth wells, into which

all refuse has been thrown for generations, and to the water being drawn from wells situated in the soil thus perforated—the air above these sources of impurity and the water in the soil being equally polluted.

It is melancholy to think of the large number of children who thus drop off like withered buds: they, however, are removed from their misery; they do not become a burden to the community, and their early removal prevents them from transmitting the defects arising from their low health to a future generation.

It may be taken as a fairly correct assumption that a large death-rate is generally an index of the existence of much misery among the survivors.

For instance, the death-rate will probably be large if the people are employed at unhealthy occupations, and if the population includes an undue proportion of young children or very old people; or, indeed, if a population is badly fed, badly housed, and the district is badly drained, we may also expect to find a high death-rate, even although the occupations are healthy, and the age constitution of the population duly proportioned.

On the other hand, if a people be well-fed, well-housed, and well-clothed (in fact well-off), and the district be well-drained and the climate moderate, we may expect, all other things being equal, to find a low death-rate.

Enquiries into the relation between sickness and death shew that there are from ten to fifteen, or sometimes more, cases of sickness to each case of death, and an analysis of these cases of sickness will generally shew that the majority of cases consists of children and the very young, or of the very old.

Dr. Farr tells us that in manhood, at the age when the earning power is greatest, there are two people permanently sick for every death. That is to say, that every death represents a loss of the wage-earning capacity of three persons.

Therefore, a large death-rate, which in itself is in great measure due to the deaths of children, represents a large amount of sickness amongst the surviving children whose after-life suffers permanent injury, and whose earning power as adults is thus reduced.

Hence the loss to the community in money power from death and disease is partly due to the actual loss of the power of earning wages of those who die, or are disabled by sickness in the fulness of life, and partly by the diminished earning power of those raised from sickly children, whose stamina has been destroyed by disease in childhood, and of whom many can only be a burden to themselves and to the community in after life.

But such a calculation takes no account of the diminished

capacity for happiness and enjoyment, of the pain suffered, and weary lives endured by those who are actually sick, and of the absence of full energy in those who, having grown up with the brand of a sickly childhood, are unable to echo the thanksgiving, "We bless Thee for our creation."

That part of the ill-health from which these children suffer which is due to defective sanitation at least is remediable, and it is the duty of the community to take steps to ensure that the insanitary conditions shall be removed.

In pursuance of that duty numerous laws have been passed, but it is only lately that the nation has begun to awake to the fact that if it is the duty of the community to prevent the use of bad water or of adulterated food, it is equally their duty to see that all persons who build houses shall build them so as to be healthy, and shall keep them in a healthy condition. In fact, no man is entitled to create property, or to use property, so as to be a source of danger to others.

If this had been recognised earlier, the vast number of insanitary dwellings in our towns would never have come into existence.

To remedy the evils which have been permitted to arise must entail expense in the near future upon individuals as well as upon public bodies, for it is certain that as a measure of safety to the well-to-do classes, insanitary dwellings must be abolished all over the country, and if private owners decline to provide healthy dwellings for the poorer classes the duty must fall on the community.

Dangers from Increasing Density of Population.

You will say that in bringing before you the importance of Dr. Farr's work, I am telling you nothing new, and that is so; but it is something to make you think of these things. I want you to realize that our danger is increasing at a very rapid rate, owing to the great increase of population which is continually going on in the limited area of this island.

Dr. Farr tells us that propinquity alone is a cause of an increased death-rate. On comparing certain groups of population in relation to the density, Dr. Farr shews that there is in these groups a constant increase of mortality running parallel with the increase of density.

Indeed, I think that unless special care is taken to provide for the sanitation of a population in proportion to the increase of its density, you may assume that if a population on a definite area increases in an arithmetical progression, the dangers to its health will increase in a geometrical ratio.

Therefore increase of population *per se* in this island may be said to be a cause of increased sickness and mortality, provided adequate provision be not made to counteract the evils.

With proper care it is quite possible to counteract many of the dangers which prevail in a dense population.

For whilst in a dense population the exhalations into the air are thicker, yet nature has arranged that the movements of the atmosphere are so rapid and so incessant that we can be sure that, with the limits yet known, however large our city is, we shall get a supply of fresh air which will remove the exhalations, provided we take the precaution so to arrange the buildings as to facilitate the circulation of air between them instead of arranging them as you generally do to obstruct it, and if we check the creation of the black smoke which forms a permanent canopy over so many of our towns; moreover if we take pains to secure the removal and destruction of refuse and provide an adequate water supply, and sufficient arrangements for drainage and cleansing, as such matters can easily be provided by combination in towns, the evils which have generally made dense districts so fatal may be mitigated. Indeed, the recent improvements in some of the denser districts of our cities in the present day have made them comparatively salubrious.

In connection with this question, I was much struck with an offer made last year by the Duke of Westminster to the National Health Society. On his valuable estate near Grosvenor Square, in London, he had some building leases which fell in, and he offered a site to the Society for the purpose of building a sanitary house. The proposal fell through; but the proposal leads one to consider the question, why are sanitary houses so rare in London?

The real difficulty of building a sanitary house in London is, that the land is so dear that when a site is once procured every inch of it is endeavoured to be occupied with buildings, and this prevents any circulation of air. It is here that the municipal authorities frequently have been, and still are, so seriously to blame. Why, if they think it necessary to obtain legislative powers to enable them to make regulations for removing the sewage from, and bringing pure water into a city, have they not equally obtained legal authority empowering them to lay down rules to secure good air? As I have already said, nature is always ready to help them. It only requires that the houses should be arranged so as to allow of free circulation of air, and that the measures which exist in abundance to prevent the atmosphere from being polluted with black smoke should be enforced, and the constant movement of the atmosphere will do all the rest. To secure however the free circulation of air it

would be necessary to prevent any building site being entirely covered with buildings.

If the various municipal authorities could and would insist that all buildings in towns should be designed and built in such a manner that air could penetrate freely and directly from the outside to every part of the inside of the building, and if they could and would, moreover, provide that, both in front and at the back, all buildings should be separated from adjacent buildings by a space at least equal to twice their height, we should ensure free circulation of air between and around all buildings.

It may be urged that the property in towns would not fetch so high a price if it were not allowed to be crowded with buildings, but no owner of property has the right to allow it to be used so as to be a source of injury to the community; and where populations aggregate together in the way they do in our large towns, the owner of property, to whom so large a profit comes from what has been termed the unearned increment, would have certainly little cause to complain if he were required to pay some attention to the health of the occupants of both his and of the surrounding property, from whom his enormous profits are derived.

Thus, whilst density of population is of itself a cause of danger, it is yet a cause which might be counteracted by increased precaution.

In England our population is daily becoming more and more dense, and although we have made great progress of late years in sanitary procedure, our progress has with difficulty kept pace with the increased requirements which result from the growing density of population.

It is certain that if we removed all insanitary causes from our midst we might reduce the death-rate of the country generally to that of our most healthy towns—probably to from 13 to 15 per 1000, instead of 20 to 23. See what has been done in the Army. The mortality of the Army before 1857 at the home stations was nearly 18 per 1000; in the year 1884, the last year for which the statistics have been published, it was 5·4 per 1000.

No doubt we have had, in addition to the sanitary improvements in barracks and the great attention paid to other matters affecting the health of the soldier, the advantage of the short service; but still with every allowance the improvement is very great.

Seeing the success which has attended these efforts, and the favourable results which have followed all improvements in town sanitation, we may well ask ourselves how it happens that after

so many years have been spent in the study, and so much experience has been gained in the practice of sanitation, and since every well-directed effort has been followed by success, we have as yet made comparatively little progress. It is true that our knowledge of sanitation is much more widespread and our condition is far better than it was formerly, but we are battling against a foe who is daily becoming stronger from the inherent conditions of our population. The growth of population does not stand still—no more, therefore, can we stand still. We must daily increase our vigilance, and daily seek out and counteract the fresh causes of disease which are continually springing up.

Direction of Sanitary Effort.

I think there are four matters needed, greater attention to which would be followed by material improvement to the public health.

(1.) *Sanitary Education.*

In the first place, the study of sanitary science has not been made an integral part of the education of our children. It has been well said that it is through the education of the young that you must influence the life of a nation.

(2.) *Legislation.*

In the next place our legislation is defective, our sanitary areas were arbitrarily fixed and are not satisfactorily adjusted. We have no adequate supervision over our rivers. The density of our population leads to pollution of our rivers, and yet we are satisfied to take no steps to prevent this pollution.

We take no steps to prevent floods, which leave their traces in sickness and low health of the population exposed to their influence.

We have no adequate supervision over the sanitation of houses, especially in towns.

We have not yet thoroughly realised that the house drainage is just as important a part of the sanitation of our towns as the town sewerage, and one in which all inhabitants are equally concerned, for the existence of insanitary spots in a crowded population is itself a source of danger to all.

If the municipal authority has found it necessary to spend large sums on providing a new and efficient system of sewerage

for the town, it is equally imperative that it should require the individual householder to supplement that work by providing the complement or continuation of that system in his own house.

Public feeling has recently found some expression on this subject. The year before last, in the draft Bill for the Housing of the Laboring Classes, it was proposed that any person who let a house furnished or unfurnished, which was in an insanitary condition, should be pecuniarily liable to the lessee or occupier of the house for any illness which might result. This provision was not made part of the Act, but in the first Session of 1886 a Bill was introduced which proposed to constitute the local authorities charged with the administration of public health as sanitary registration authorities in their respective districts, and it provided that previous to June 1, 1888, each sanitary registration authority constituted by the Act was to cause notice to be sent to the owner, lessee, sub-lessee, or occupier of every building occupied or intended to be occupied, either permanently or temporarily within the area of its jurisdiction, calling upon the said owner, lessee, sub-lessee, or occupier, to deposit with the registration authority a certificate for such building. The Bill further provided that previous to January 1, 1889, the owner, lessee, sub-lessee, or occupier of every such building was to cause a certificate to be deposited with the registration authority declaring that the said building is in a satisfactory sanitary condition, such certificate to be signed or sealed by some one of the following persons or corporations, that is to say—Members of the Royal Institute of British Architects and Members of the Institution of Civil Engineers, who are in practice as architects, surveyors, or civil engineers; also architects or civil engineers who have been in practice five years at the passing of this Act, and who register their names accordingly with the Local Government Board before January 1, 1887; also by Sanitary Associations incorporated by license of the Board of Trade, medical officers of health and medical practitioners qualified in sanitary science; also by the surveyors and engineers of local authorities so far as their own districts are concerned, and such other persons as the Local Government Board may authorise.

The Bill further proposed to provide that after January 1, 1889, it should not be lawful for any dwelling house, school, hotel, hospital, or other building, to be occupied either permanently or temporarily, unless a certificate had been deposited with the said registration authority in accordance with the provisions of the Act.

The Bill did not become law, but it is certain that before long steps will be taken in the direction of the proposals incorporated in it.

(3.) *Trained Sanitary Advisers.*

In the third place we require trained advisers in practical sanitation. Your medical officer of health has qualified himself for his position, for he cannot be admitted into his profession until he has passed necessary examinations; but it seems to be considered that any engineer, whether he has studied sanitary science or not, is qualified to have charge of the sanitation of a town, and often that any person, whatever his previous occupation, will do for a sanitary inspector or inspector of nuisances. But this is a fallacy, for consider for a moment the variety of matters by which the health of the community is daily endangered. We are touched at every point by disease causes. For instance, in the question of food, there is selection of food, adulteration of food, and preservation of food.

A few years ago a great outbreak of typhoid fever in London was attributed to pollution of milk by sewer gas; the milk received from the country having been stored by the milkman in a confined place in the basement of a London house, to which there was direct access from a main sewer.

Newer theories allege that the habits and diseases of animals are closely associated with the disease causes of the human race, and that scarlet fever may sometimes have its origin in the neglect to notice a specific disease in the cows from which you obtain milk.

But even where our attention is awakened, and where we have introduced sanitary works, we often find that causes of disease arise which are intimately associated with the sanitary improvements which we have devised. Your well water may in itself be pure, but it may become polluted from infiltration, because you or your neighbours place at no great distance from the well a heap of refuse, or because you let the paving round the well get out of order, so that dirty surface water finds its way in. The water pumped into your cisterns may be pure, but if your cisterns are not carefully arranged, and if you do not clean them the water in them may become polluted, and then they may themselves be a source of danger.

The filter on which you rely, if used for many weeks without cleaning, may make water, otherwise wholesome, dangerous to drink.

You have ventilating openings; but the tubes or flues which bring in fresh air will, especially in closely inhabited areas unless frequently cleaned, become receptacles of dirt, and render the air foul.

You have hot water pipes to warm your house; but if these are placed in chases in the wall, or in flues where dirt is allowed

to accumulate, they will assist in spreading impure air in your house.

Your drains may be designed on the best principles; but they are concealed in the ground, and unless they are carefully made, sound and water-tight, they may pollute the ground below your house, and become a source of eminent danger.

Let me give you an illustration; it happened only a fortnight ago:—

I am on the council of the Girls' Public Day School Company. We have above 30 schools; we employed a gentleman of eminence as Architect of such buildings to build one of our largest schools; recently we felt it desirable to examine the drainage of all our schools. Let me tell you what was the report on the condition of the drainage of this particular school, which drainage passes under the building: "To a great extent the drains not only fall the wrong way, but are absolutely without any jointing in many cases. In another case the pipes do not meet within two inches, and here a joint has been made with zinc and string; this is under the kitchen."

Is it not remarkable that an architect of position should have permitted the drainage under this school building to be constructed in such a manner as practically to ensure that the ground should in course of time be saturated with sewage? The only inference which can be drawn is, that the architect cannot have understood much of sanitation; for any other supposition would imply that he cared little for the lives of the hundreds of children who were to be congregated in the building.

Again, your house may be constructed upon the best sanitary principles; your drains may be sound and water-tight; and everything may be beyond suspicion as to freedom from sewer gas, or impurity in the water supply; but if that house is constructed, as is so frequently the case, upon ground which has been used for refuse and rubbish heaps, the good drainage within the house will be no security against the penetration of foul gases from below.

Let me give you an illustration also of this peril. It has lately happened to a friend, with whom I am intimately acquainted, that, although his house had been built with every possible care as to sanitary matters, there were repeated outbreaks of scarlet fever among his family and household. Every expert who enquired into the causes of these outbreaks failed to discover any flaw in the internal arrangements; but upon enquiries being made in the neighbourhood, it was found that the whole row of houses had been built upon rubbish heaps, and that every house in the row had had outbreaks of fever.

Indeed the more we pursue our sanitary enquiries the more

do we see the complexity of the problem; and hence investigations into disease causes and into the sanitary condition of a locality or of a house, in order to be thorough, require skill and experience.

Sanitary work, to be of much value, or of a comprehensive nature, must be undertaken with a clear idea of the dangers to be averted, and the good to be attained. It is a scientific work, and scientific methods must be adopted.

It is because neglect is so common, or because so frequently a person who has no real knowledge of sanitary science has been called in to devise remedies for what he does not understand, that sanitary science has often been discredited, and that much expense has been incurred in so-called sanitary works which have not only had no useful effect in themselves, but which have produced new and hitherto unsuspected causes of disease.

(4.) *Notification and Isolation of Infectious Disease.*

There is, however, one matter of sanitation in which we are singularly remiss, and that is the arresting of infectious disease at its first appearance.

Dr. Farr's pages show you that in tracing out the sanitary history of a community the statistics of illness from those diseases which are favoured by insanitary conditions are as essential to possess as the statistics of the deaths. Indeed, sanitation can only rest upon a sure basis provided the statistics of sickness from epidemic diseases, as well as those of death and the probable causes of these occurrences, are accurately recorded and intelligently studied.

The registration of sickness would designate the localities where disease is most rife, as well as those where there is less tendency to particular classes of disease and infirmity; it would, moreover, indicate the extent to which epidemics vary in different localities, seasons, and classes of society. But, to obtain this knowledge with accuracy, it would be necessary that all the cases of epidemic disease, as well as of the deaths, should be accurately recorded, collated, and carefully considered, by skilled persons, in their relation to the conditions which prevail in the several localities where they occur; and that the areas of registration should be smaller than they now usually are, and that they should be more carefully adapted to the sanitary condition of the localities.

Notwithstanding all Dr. Farr has done, we have by no means perfected our system of vital statistics, for we have not yet established any general registration of epidemic disease.

It is true that for certain towns the notification of certain

infectious maladies is enforced; but what we want is that this should be extended to the whole kingdom, and that the sanitary authority in every locality should be informed at once of every case of dangerous infectious disease occurring in the district, and that the sanitary authority should be empowered and required to see that the case is at once isolated. This would be a step of forward progress, the importance of which is illustrated by some remarks in an address made by my friend Mr. Michael, Q.C., to the Sanitary Institute on this subject:—

"How do we deal at the present time with cases of infectious diseases occurring in our midst, one of the great sources of danger to the public health which we can easily stamp out, but which we deliberately allow to run on its course unmolested? If a member of our own family should unhappily be laid up with an attack of measles or scarlet fever, we, as soon as it is known, become isolated and cut off from our social belongings. Our friends no longer call upon us, we are prevented from going into society, and our acquaintances when they meet us rein up their horses at a safe distance from the curb of the pavement on which we stand, while they enquire as to the sanitary condition of our little home community. At the same time these very friends and acquaintances, in shops or warehouses which they frequent or use, in laundries, and in workshops, are daily shaking hands with infection, and dealing directly with persons who come straight from their habitations where infectious disease is present, and who, in their clothes and otherwise, convey to the unsuspecting the matters which engender disease. The tailor who makes or mends our coat does so in the company of measles or small-pox; the laundress, who is busy with the garments soon to be applied as coverings to those we love best, bestows her care equally on the snowy surface of our linen, and on the scarlet desquamating skin of her child, and then we wonder at the spread of infectious disease, and that so little good results from sanitary measures, as though sewer and ventilating apparatus outside our houses were all the protection that is required to ward off disease, and that the interiors, and all that there occurs, is beyond the need of our attention and our laws."

Instances are numerous of the evils resulting from the want of isolation. Let me quote one from the Report of the Royal Commission on Small-pox and Fever Hospitals:

> "A very remarkable case occurred two or three days ago; six children were admitted upon Saturday night last to the hospital at Stockwell. They all belonged to one family, and lived in a small apartment at the top of the Haymarket; their father is a tailor working for a fashionable tailor in the West End of London. About three weeks ago one of his sons (there were nine in family altogether) had small-pox, which was treated at home, and was not notified. All the others caught it. The six children were all brought into the hospital on Saturday night. All the nurses who witnessed their arrival said that they had never seen such a horrible sight. One boy died four hours after admission, two girls died three days afterwards, and three are still left exceedingly ill; the ages of the children being from fifteen to three years. Now if the first case that occurred had been notified and isolated, all this distress and misery might have been avoided.
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> "In the lower floor of the house where the tailor lived was a laundry employing five women, who came every day, where washing was taken in from the neighbouring families."

Similarly, in regard to scarlet fever, it is instanced in the same Report that in the Alcester rural district in Warwickshire, the early removal of cases of scarlet fever from houses which contained children, who were unprotected by having had previous attacks, had prevented any spread of infection. For example, in three instances the first pupil attacked had been removed from school, and in each of those cases no spread took place; whereas on another occasion when scarlet fever attacked a pupil at a school, and it was attempted to treat it in isolation in the school building, the disease spread, and seven other attacks followed in the schoolhouse.

As a contrast to this, let me quote to you the experience of Leicester, which we visited last year.

Now, that town is very heterodox in some of its opinions. The population seems to reject the theory which is, I may say, now all but universally accepted by civilized mankind, that that dreadful scourge of small-pox should be arrested by compulsory vaccination. The efficacy of vaccination and re-vaccination in checking the ravages of small-pox has been fully proved by a practice which has extended over nearly a century of time, and which has been in operation in every civilized community on the face of the globe. But what I want to draw your attention to is this, that whilst Leicester declines to believe in the necessity for compulsory vaccination, it has yet enjoyed for many years an immunity from epidemics of small-pox.

This temporary immunity has been attained by strict care. Leicester has long stood forward as a pioneer of sanitation, and as a sequence to its other sanitary work, Leicester was one of the first towns to procure an Act for the Notification of Infectious diseases. As soon as a case of small-pox is notified, the Municipal Authority takes immediate steps to remove the case

to hospital, and to disinfect premises and clothing. They also persuade the occupants of the house where the case is found to go into quarantine for a fortnight at the expense of the town. The necessity for this has been proved, as persons so removed were sometimes found in two or three days to be affected with the disease. They have no compulsory power beyond that given by the Public Health Act, which applied all over the kingdom; but if householders refused to go into quarantine they would send an officer every day to enquire at the house, so that the danger of infection should be reduced, and of course it would be their duty to warn persons of the penalties they were liable to if they exposed others to contagion.

In Leicester, in 1852, there were fifty-two deaths from small pox, in 1858 there were fifty-three, in 1864 there were 104, and in 1872 there were 346; that was before they had the Notification Act, or any means of efficient isolation; since that time, and under their present method, they have not had a single epidemic of small-pox, and a large number of single imported cases have been dealt with, and the disease in each instance stamped out. Similarly I am informed that small-pox has been kept away from Cheltenham, which has no compulsory Notification of Diseases Act, but where the medical men are all strongly interested in stamping out the disease.

It is said that the compulsory notification of infectious diseases is not looked upon favourably by medical men. I will therefore quote the experience of the Medical Officer of Health of Leicester on this subject:

"It is now over four years since the notification of their infectious cases was first required of the medical men in the town, and I am happy to say that the evils anticipated by the profession from their fulfilment of this duty have in no way been realised. Their carrying out of the clause, at first considered so objectionable, affords conclusive proof that the fears entertained as to the result of 'breach of confidence' upon their part to the patients under their care have had no actual foundation in practice, for no single instance has come to my knowledge where notification has in any way disturbed the previously-existing relation between a medical man and his patient. The profession now fully co-operate with the Health Committee in this matter."

I quote this experience because it shows how much may be done by isolation to prevent the spread of an epidemic, even as virulent and contagious as small-pox. The object to attain in the case of infectious diseases, such as small-pox, scarlet fever, diphtheria, and others, is the immediate isolation of the patient when the disease first shows itself. Certain conditions are

necessary to secure this. The first is, that every case of infectious disease should be promptly notified to the authorities. Second, that the patient should be at once isolated; thirdly, those who had been in immediate contact with the patient should be retained for a period under observation; fourthly, the premises where the case occurred should be cleansed and disinfected, and any sanitary defects in them should be remedied.

In the enforcement of these conditions there should be no distinction between rich and poor, pauper and non-pauper cases, except the distinction between persons who can and persons who cannot be isolated at their homes, or in some place approved by the proper authorities. In default of such isolation, the authorities should be empowered and bound to remove to the hospital any patient capable of removal without risk to life or aggravation of the disease.

I have been the more anxious to bring this question to your notice, because the rapid increase of our population in the restricted area of this island makes it imperative that we should adopt every precaution which our advancing knowledge points out to mitigate the tendency to the spread of disease which Dr. Farr has shown to be inherent to an increase of population, when additional sanitary precautions do not follow that increase.

In the metropolis this question is of especial moment. There, at the rate of increase which has been steadily maintained since the beginning of this century, the population will in another twenty years amount to probably 6,000,000. Considering how large is this aggregation of human beings, we must acknowledge the great progress which has been made of late years in the preservation of the health and prolongation of life; because, even if in late years the death-rate had remained stationary, we might have congratulated ourselves upon having at least overcome the effect of the increase of density of population by our sanitary measures; but in fact the rate of mortality has actually and largely diminished. We may attribute this gratifying fact in part to improved drainage, and to the large amount of wretched house property which has been cleared away under the various Acts for improving the dwellings of the labouring classes, by which, not only have improved dwellings been substituted, but open spaces have been created, admitting of circulation of air, and preventing the accumulation of refuse in the inside of the dwellings. Moreover, the metropolis has spent large sums of money in endeavouring to cope with epidemics of small-pox and fever. The care of those who suffer from these diseases has fallen to the lot of the Metropolitan Asylums Board, who opened three hospitals in London in 1870

and 1871, and two more at the beginning of 1877, under the provisions of the Metropolitan Poor Act, 1867.

On referring to the Registrar General's Report for 1883, you will find there is a Table shewing zymotic diseases for certain decennial periods.

From this Table it appears that the deaths in London from small-pox between 1841-50 were at the rate of ·4 per 1000 persons; 1851-60 were at the rate of ·28 per 1000 persons; 1861-70 were at the rate of ·28 per 1000 persons; 1871-80 were at the rate of ·46 per 1000 persons—that is to say, in this last decade the death-rate from small-pox averaged nearly two-fifths more than it had been in the two previous decades, and in 1881 it was ·62 per 1000.

Whilst, therefore, the rate-payers of London were spending large sums of money in the treatment of small-pox, the disease which should have been limited, if not prevented by the expenditure, seemed to increase rather than decrease its ravages.

But during the last severe epidemic of small-pox, which began in 1884 and ended in 1885, the Metropolitan Asylums Board took a new departure; they arranged to remove all cases of small-pox from within the metropolis, and treat them away from the population; the system now in force is to convey the patients by ambulance carriages and ambulance steamers to hospital ships in the river at Long Reach, 20 miles below London Bridge, and when they begin to convalesce to remove them by an easy drive to a healthy site at Darenth, on the range of hills not far from Dartford, where they remain till they are considered free from infection.

At the present time there is very little, if any, small-pox in the metropolis; we may assume that this is in some degree the result of the action of the Metropolitan Asylums Board in at once removing all cases from the midst of the population; but there are also individual agencies which assist. For instance, some of the Medical Officers of Health seek "voluntary notification;" Dr. Dudfield, of St. Mary Abbotts, Kensington, mentions in his last report the sources from which he obtains information of the occurrence of infectious diseases in his parish. These are Sub-district Registrars, Sanitary Inspectors, Relieving Officers, the Asylums Board, Resident Medical Officers of Hospitals and Dispensaries, Medical Men, the Police, the Postal Authorities, School Board Visitors, Clergymen, and District Visitors. I mention these to shew the difficulties which meet the energetic Medical Officer of Health who seeks "voluntary notification." But notwithstanding these difficulties, Dr. Dudfield shows satisfactory results. A comparison of the 12 years period 1859–70, before voluntary notification and Hospitals, and the 12 years period 1871–82, with voluntary notification and with Hospitals, shews that there was a net decrease of infectious disease in the second period amounting to an estimated saving of 1441 lives. The progress which we have made in checking infectious disease is an evidence that we ought not to be content with what we have already done; we ought to take a further step. For the metropolis, with its daily increasing population, is consequently subject to a continually increasing risk from infectious disease; and yet it neglects in these arrangements one of the links in the chain of prevention which is shewn by the experience of Leicester and nearly 40 other large towns to be so important.

The notification of disease, the isolation of all patients whether rich or poor, the careful observation of all those who have been in contact with the patient, the disinfection of the house in which the patient resided at the time of his attack, and the removal of any sanitary defects which may be found in the house, I have already shewn to be links in the same chain. They are necessarily more difficult to secure in a great city like London which, nevertheless, all things considered, enjoys a remarkable degree of salubrity with a comparatively small zymotic death-rate. Nevertheless, it must be said that until similar measures are made compulsory in the metropolis, and in the country generally, we are neglecting a powerful means of preventing the spread of small-pox and other infectious diseases.

The metropolis, unlike other towns, is not under one municipal authority; the direct management of the infectious hospitals in the metropolis is under the Metropolitan Asylums Board, but this Board has no initiative power, and its proceedings are controlled in great detail by the Local Government Board. That Board is charged with the control of the sanitary legislation of the whole country; and seeing the success which has been attained in those towns which have of themselves adopted the notification of epidemic disease, that Board is neglecting a grave duty by not making any effort to induce Parliament to protect the community from epidemics by introducing and securing the success of a measure providing for the notification and isolation of epidemic disease.

Conclusion.

In this address I have been barely able to touch upon a very few of the interesting points raised in Mr. Humphreys' *Selections from Dr. Farr's Writings on Vital Statistics:* but I hope that

these small instalments may be the means of inducing many of you to study this very interesting work, for it is an epitome of sanitary knowledge and research. And whilst it illustrates the genius of Dr. Farr it also serves to remind those who had the good fortune to be acquainted with him of the geniality of his temper and the charm of his conversation.

The Rev. Canon Fleming (York) moved a vote of thanks to the lecturer for his valuable paper. In doing so he said that he believed that statistics had proved over and over again what the lecturer had told them that night—viz., that the transmission of those germs of evil by which they were surrounded was one of the great causes which lowered the national life, whether it be in health or in its moral tone, and therefore everything that could be done to get rid of those germs was in the direction of raising our national life.

Professor de Chaumont (Southampton) seconded the resolution, and spoke eulogistically of the lecturer's life-long labours in the direction of sanitation.

The resolution was heartily adopted.

Sir Spencer Wells, Bart. (London), proposed a vote of thanks to the Chairman (the Dean of York), and said that the support of the Dean and clergy had been of the very greatest assistance to the York Congress.

Professor W. H. Corfield (London) seconded the motion, and it was carried with acclamation.

The Dean of York, in replying, said that the clergy might do a great deal of good amongst a large class of the people by endeavouring in a kindly manner to get them to attend to those sanitary precautions which were so commonly overlooked.

THE ARTISTIC SIDE OF SANITARY SCIENCE.

ADDRESS TO THE WORKING CLASSES.

By Edward Cookworthy Robins, F.S.A., F.R.I.B.A.

Sanitary science is but the knowledge of that which tends to the promotion of Health. The principles upon which such knowledge is founded are the same as those which form the bases of all the sciences, and result from the observation and study of natural laws. That the application of principles resulting from scientific research to the promotion of the Public Health has been the special duty and delight of the medical profession, goes without saying. Nevertheless, it is sometimes forgotten that this application takes a twofold form and purpose—viz., *Curative* and *Preventive*. The *former* takes disease as it finds it more or less developed, and strives to overcome its ravages, and to restore by healing arts the health which was lost. The *latter* takes health in its various phases, and strives to preserve it. In the former case the physician and the surgeon have to work comparatively unaided by other professional men outside their own body. In the latter case everyone can come to their assistance, and aid in the spread of the said principles and in the development of their practical application to the daily requirements of every living thing.

The Council of the Sanitary Institute of Great Britain is, for the most part, composed of gentlemen belonging to those professions which, more than any other, are concerned in this crusade against all forms of preventible disease—viz., Medical men, Civil Engineers, and Architects.

In the proper exercise of its functions, the Council has determined this year to give to each of these professions a representative voice, who shall speak to the artizans of York, in congress assembled, something more or less memorable from the triple points of view embraced by the three professions referred to.

The distinction between the medical profession and the other two is sufficiently obvious, but the difference between the engineer and the architect invites a few explanatory remarks. The title Civil Engineer is a modern one, and is distinct from that of military and naval. All three were originally comprised in the title, Architect—civil, military, and naval architects. Of late years the tendency has been to split up professional work into special branches, it having been found quite sufficient for most men to follow one branch in particular, and through the practice and special study of that branch to become acquainted with its every phase, thus fitting themselves to carry on scientific research therein, by which means the knowledge so acquired is duly classified and recorded for the benefit of succeeding practitioners and the public service.

Not only has civil engineering become a special profession, but it has itself been split up into various departments, only the select few—men like Stephenson and Brunel—practising in all the branches: thus there are civil and mechanical engineers, hydraulic and gas engineers, telegraphic and electric engineers, &c., &c., and, lastly, *Sanitary Engineers*, or men who have specially devoted themselves to the drainage and water supply of our towns and villages. Moreover, the engineer has mainly to do with public works of utility and convenience, either for Government, municipal bodies, or public companies, whereas the architect has chiefly to do with buildings; and although his constructive knowledge may be equal to that of the engineer, and be as necessary to him in the design and realization of such a building as St. Paul's Cathedral or the Houses of Parliament, yet there is a point of division which makes all the difference between them. The architect must not only be a builder, he must also be an *artist*. It is the artistic side of his profession which separates him from the engineer. He has not only to "build in truth," but he has also to "design with beauty."

In the few remarks that I shall have time to make this evening, I shall endeavour to quicken your interest in sanitary science from an *artistic* point of view.

I am quite aware that both engineers and architects have greatly interested themselves in sanitary appliances of houses, and that there exist at the present time specialists in both professions, whose practice is within the house as well as outside of it; but their work is chiefly required to overcome evils already existing, the deplorable extent of which is fully known only to those who have had special experience therein. But, broadly speaking, the engineer has to do with the public sewers and gas and water supply, while the architect has to devise the house drains and private gas and water supplies. Both are designers

only—their works are executed by contractors under their supervision, and in accordance with their plans and specifications. And even the contractor does not himself do the works, as a rule; he finds the men, the money, and materials, but the work is really done by men of the class which I am specially invited to address to-night, and whose presence here is the best evidence of their interest in the subject.

I can imagine some of you to say, What in the world can sanitary science have to do with artistic matters? Well, that is the question to which my remarks will be a reply, and I trust my answer will be sufficiently clear to commend itself to your judgment and to enlist your sympathy.

Primarily.—The non-adaptability of means to ends is not only unscientific, but it is eminently inartistic, nothing is beautiful that is not in harmony with its uses, or that is opposed to the first principles of natural science. Everything has an element of artistic completeness, which more or less answers the purposes for which it was designed. The fitness of things is in itself artistic; indeed, it is the only true foundation upon which to build up the accessories in form and colour which constitute the decorative aspect of those things of beauty which are "a joy for ever." There is a moral quality in all good and true work, a reasonableness in all honest labour, which, fully appreciated, brings its own reward. Perfectly to do anything is eminently artistic. It satisfies the moral and scientific aspirations of the individual and edifies others, and it is specially necessary to be done in hygienic operations.

The use of good materials and workmanship is therefore a fundamental characteristic of artistic sanitation.

The artistic workman has pride in his work, and does not do it only because he is to be paid for it; he has a taste for good materials, a love of good workmanship.

Such a man, having secured a site on gravel or chalk and perfectly free from obnoxious surroundings, studies the aspect and takes care that his rooms shall share in some part of the sunlight of the day.

If the substratum is insufficiently firm, he will make a concrete base for the walls to stand upon, mixed with river ballast and ground lime or cement, as the dry or wet soil may require; and not only so, but he will cover the whole area of the house with a layer of concrete 6 inches thick, and he will utilize this covering as a base for a cement, tile, or wood block flooring, by which the ground air and moisture will be excluded from the basement. This is better than constructing boarded floor on joists and sleeper piers, however well ventilated.

There are many ways of laying block floors, nearly every

system sets them in pitch on a dry prepared surface; some are dowelled together and screwed to plugs set in the concrete, some have dovetailed grooves at the bottom side, and the block is pressed into the asphaltum bedding; but all are required to be of thoroughly well-seasoned wood, and if of oak or pitch pine or other hard wood nothing is a better finish than wax-polish.

The artistic workman looks forward to be the purchaser, if he is not the builder, of his own house, and he recognizes the importance of preventing damp rising in the walls by the addition of a damp course built in at the level of the ground.

A single course of slates in cement is no use at all, but two courses of slates in cement laid between two courses of bricks in Portland cement answers very well. I have recently underpinned the whole of the walls of a large house, for the insertion of a layer of Hygeian Rock, in which case a single course of slates in cement of inferior quality had been laid, but the damp had risen in the walls some four or five feet in height by capillary attraction; so wet were the walls that the plaster was saturated, and had to be removed, and the walls covered with Portland cement. And this is not an uncommon thing. I have thus underpinned at least half a dozen houses for one client, the rents of which averaged £200 a year. In addition to this, I have had to put land drains, and to cover the earth with concrete, besides new drainage and new plumbing throughout, involving an average cost per house of £500.

The artistic workman of my imagination will have none of this to do in any house he buys or builds. He will see that there are damp areas as well as damp courses, and will suffer no soil to be banked against the house walls. Damp areas, half a brick thick, with half a brick space between them and the wall, are better than nothing, but they are not efficient protectors unless the walls are first rendered in Portland cement, and have a pure cement or tile water channel beneath, with outlets for the same to the drains, which, however, it is difficult to keep clear. I have had to remove a great many and to substitute open areas at least a foot wide below, and 18 inches above lined with cement, with pure cement semi-circular bottom, forming a rain water channel.

My own house is thus surrounded with open areas, provided with occasional Deane's trapped gratings for connection with the underground drains, laid straight to the man-holes which intercept them at all angles, the sewer side of the last man-hole having a syphon trap fixed.

The laying of such drains to proper falls in straight lines, embedded in concrete where under the house, with well-cemented joints, should be capable of resisting the water or smoke test without leaking; and this, with an inlet and outlet for ventilating

purposes, is an essential part of house sanitation artistically considered. Things out of sight are commonly out of mind, and are immorally executed with bad materials and workmanship.

The artistic workman will also be particular about his walls, he will avoid bond timber, which decays, and substitute galvanized iron hoop-bonding, tarred and sanded. He will insist on the footings of the wall spreading to twice the width of the wall over them, he will have the joints well flushed up and solidly compacted, well wetting his bricks in dry weather. He will build in English or Flemish bond, and he will not cut off the headers of the facing bricks and thus weaken the bond for falsely economical reasons. He will not consent to use porous bricks for facing because they are pretty in colour or texture. In like manner he will provide good mortar, he will object to road scrapings for sand, and will insist on clean sharp pit or river sand mixed in the right proportions. He will not sift the mould of the site, and think to evade the cost of good sand by using it instead, mixed perhaps with sea sand brought by the railway, to the curse of those who buy houses built with it.

I have just had to entirely strip off the cement stucco facing of a large house down to the bricks, and to re-cement the whole, owing to the bad quality of the cement and sand, and the defective mixing of the same.

The artistic workman of whom I speak will take care to construct his flues so as to avoid down draughts, which is quite a preventible disease in houses, if thought of in time. He will practically aid the Smoke Prevention Society by using stoves that will radiate heat and consume their own smoke at one and the same time, and be pretty to look at into the bargain. He will utilize the solid divisions between his flues, by building in Boyd's iron flue plates, and so gain an extract ventilating flue warmed by the ordinary smoke flues, and he will admit air at the side opposite the fire-place through a ventilator having an upward current capable of being closed at pleasure. He will not disregard the advantages of hollow walls, or an intervening vertical lining of Hygeian Rock asphalte, by which the walls of the house may be made entirely wind and waterproof.

The artistic workman will see that the Fir timber he uses is of well-seasoned Baltic growth. He will have sound Christianna deals for his joinery, and discard all miserable sappy, shaky, pithy stuff, that chips at every blow, and being unseasoned, shrinks and twists after fixing, causing gaps and cracks in doors and window frames, and letting in dust, and draught, and rain, while the sashes rattle in the wind. He will insist on having oak sills sunk and weathered and grooved for weather bars, and require thief proof sash fastenings, and brass axle pulleys in-

stead of iron, which rust and stick. He will want deep lower sash rails and high cill beads, so that he may raise the window for admitting air at the meeting rails of the rising sashes without making draughts; I doubt if he will have anything to do with casement sashes, if he can't afford Espagnoletti bolts for fastenings.

The artistic workman rejoices in broad eaves; he likes the shade and shelter that overhanging roofs afford, and he prefers the hard burnt Broseley tiles for a covering, because they look solid and strong, and are cool in summer and warm in winter, and he does not grudge stout timbers to carry the extra weight of them. If he lives in a town, he cheerfully obeys the provisions of the Building Act and the Sanitary Acts of Parliament prevailing, knowing very well that they are designed for the public weal to prevent the spread of fires, and to check preventible disease by sanitary precautions in which every one has a share in the profits arising from the healthiness of the neighbourhood resulting therefrom. If he does not use tiles, he prefers slate or lead to zinc, but if he should be obliged to resort to the cheaper material, he will only have the best and the thickest, laid with laps discarding the use of solder, so that it may adjust itself to the temperature, and he will only use cast iron eaves, gutters and stack pipes, galvanized or coated with Angus Smith's solution.

The artistic workman knows the value of good honest plumbing for the internal fittings of the house. He will have external soil pipes carried up to the roof for ventilation, and to prevent syphoning the traps. His waste waters and sinks and baths he will discharge over trapped gully gratings, to secure proper disconnection from the soil drains, and he will not have drinking water drawn from the W.C. water supply. He will cover his walls with non-poisonous paints and non-arsenical papers, which he also chooses of agreeable hues made washable, if not varnished. But he thinks it good economy to varnish both paint and paper throughout, and not only his walls, but also the borders of his floors: his carpets being always an easily removable square with border. He does not covet grandeur or gaudy colouring, but he loves good forms and outlines, and the soft harmony of secondary tints.

In short, our artistic workman is a remarkably sensible man, the excellence of whose materials and workmanship is visible at a glance. By their deeds such men are best known, and the moral quality of their labours is itself an æsthetic triumph of the most salutary description.

Secondarily.—The published papers of the conferences and lectures at the International Health Exhibition have put on

record an encyclopedia of knowledge upon sanitary science and its collateral branches, which will be of increasing value as it is read and studied by all interested in the subject, and to some of these subjects I shall now make reference. The arrangements which make healthy or unhealthy houses in town or country were well discussed and illustrated by Messrs. Eassie and Rogers Field, and are well worthy of study.

As secretary of the conference organised by the Royal Institute of British Architects, I read a paper on "Impermeable walls, floor and roof coverings," to which I must refer you for popular information on the exclusion of damp air, dry dust, and heat and cold from our dwellings.

Mr. Aitchison, one of the lecturers on architecture at the Royal Academy, discussed "the sanitary aspects of the inside fittings and decoration of dwelling houses."

Mr. White, previously known as the writer of papers on "Æsthetic sanitation" as applied to the humn figure, expounded "the hygienic value of colour in dwellings;" while Mr. Edis elsewhere discoursed on the sanitary principles which should govern the furnishing of dwelling houses. Thus, it will be seen that the artistic side of sanitary science has not been altogether overlooked by architectural writers, and is not so novel a subject as at first sight it may seem. Let us further consider the matter under the head of personal sanitation.

1.—Personal Sanitation.

The author of "Ethics of the Skin"—(another paper read at the "Healtheries") draws attention to the sevenfold functions of the skin.

1.—"It is a protection to the external surface of the body, and supports the internal organs. 2.—By means of the nerves it imparts to us sensation of touch, pressure, temperature, pain. 3.—It secretes oil. 4.—It is an organ of respiration supplementary to the lungs. 5.—It has powers of absorption. 6.—It acts as a purifier. 7.—By the aid of perspiration the heat of the body is regulated and retained at an equable temperature."

A.—*Personal Cleanliness.*

To enable the skin to exercise these various functions it is absolutely necessary it should be clean, and the morning bath is as essential to every part of the body as to the face. Fortunately fashion is on the side of right in this case, and nothing is more characteristic of good breeding than the performance of frequent ablutions. Lola Montes, the famous dancer, who cap-

tivated the foolish monarch of Bavaria, attributed the preservation of her beauty to her careful washing. It is said she bathed in milk and warm and cold water; and it is well known that the suppleness of the Indians and their silky skins are due not only to exercise, but to anointing their bodies with oil and frequent bathing.

Fashion is a capricious mistress, and her ways are not always so wise as in this instance—as when she decreed that powder should be applied to the cheeks from morning till night, "to the utter destruction of the complexion, which is sufficiently attested by thousands of skins," says our author, "puckered and pitted, which but for the use of powder would have remained to this day as soft as silk. As the powder dries up the moisture which the glands of perspiration in the face supply, more and more is secreted, till the glands become unable to fulfil their task, and shrinking, produce the little chasms that give the orange-rind appearance that is but too familiar to all observant people."

In a paper on "The Ethics of Art," I myself drew attention to a phase of art which is thus graphically referred to by the same writer:—"There has lately sprung up a taste in art that can only be postulated as a taste for disease—a leaning towards the outward expressions of decrepitude and decay. It is attempted to exhaust sentiment and beauty from the weariest phases of human wretchedness. In one school, at least, of this art movement, we find woebegone women, ill, limp and unwholesome. They look thin, weak and weary; their complexions are not those of health, and their attitudes are of a long-enduring debility. The men, too, are not more attractive in a sanitary sense; they look like an army of convalescents; they appear ill-fed and out of condition, and have the aspect of those that are in pain."

And thus it is that the common practice of darkening the eye socket, to increase the apparent size of the eye, is but a mimicry of the wasting in consumption. But beauty cannot grow out of deformity, nor thrive as the semblance of disease. The unfitness of the association is condemnatory of its artistic character. It is as inartistic as it is insanitary.

B.—*Physiological Considerations.*

Violations of physiological laws are the fruitful causes of unhealthful and of inartistic forms. I have no need to say much on this head: perhaps it is not so much ignorance as vanity that leads unthinking people into fashionable errors of this kind.

The author of "Æsthetical Sanitation" remarks that "the

bearing of health on true beauty, and of true beauty upon health, has not met with the recognition which, in these days of art and science, its investigation might be supposed to deserve. The injuries arising from ill-shaped, or tight, or high-heeled boots and shoes are very serious to the figure and gait, but still more so to the general health, through the manner in which the distortion of the foot, and of its position, acts upon the muscles of the hips and spine. But there is some hope to be derived from the popularity of the rational study and exercise of the body involved in the wonderful gymnastic system of which Colonel Ling, of the Grand Central Institution, Stockholm, was at once the author, exponent, and professor; by which system more than 500 muscles of the human frame, together with many thousands of nerves, are thoroughly and equally exercised and trained."

"To trip it lightly as you go
On the light fantastic toe,"

is a poetical fancy, a joy unknown to those who submit to their feet and ankles being distorted by this fashionable but inartistic folly.

Again, Sanitary Science and natural laws, and the highest embodiments of physical beauty of classic art, are at once ignored by the strange distortion of the body, and the extraordinary compression of the vitals, produced by the senseless and inartistic practice of "tight lacing."

But what can we expect uneducated people to do, when some would-be leaders not only of fashionable but of literary society, write as if it were a mark of distinction, an evidence of blue blood, to be possessed of a waspish waist. The lady's riding horse and the common dray-horse have been compared; and, in like manner, delicate women of refinement and grace are said to be gifted with this peculiar elegance, so called.

Well, granted that some women are weaker and smaller than others (for it is not exclusively the characteristic of the well-born), let it be remembered that, in so far as it is natural, it is in harmony with the whole frame of which it forms a part, and in such persons it is not the unsightly thing it becomes when the body is forced out of its natural harmony of form, into a shape which fashion dictates, and nature disallows and rebels against by insidious disease.

In Elizabethan times, as in our own, the natural form was completely transformed, and the beauty of classic models entirely ignored. But in these later times surely this fashionable tyranny is doomed to decay since the charms of the

Grecian examples have been pictorially represented and personally appropriated in the lovely Grecian dramas that have lately graced the stage under the guidance of Sir Frederick Leighton, and of Mr. Godwin, the architect.

The sculptors of Greece have never been surpassed; their system was peculiar to themselves and perfectly natural. They did not copy deformed or even ordinary persons, but made selections of finest examples of head, arms, legs and torso from several models, and so built up representative men and women, and held them up as standards of beauty for all to emulate. When Xeuxis sought to impersonate Helen of Troy, a city was ransacked for his models, and Edwin Long has immortalized the story by his wonderful pictures, now exhibiting in Bond Street, of the "Choice" and the "Selected Five."

The highest art is the healthiest—the noblest ideal the most salutary, morally and physically—let us not be behind the ancients in our power of realizing the truly artistic character of sanitary science.

C.—*Personal Attire.*

In my address delivered at the Sanitary Exhibition at Eastbourne, I remarked that, in the matter of *Dress*, sanitary science reveals to us that aestheticism in attire is not beautiful if it seeks to disguise or distort Nature's loveliness; if it is so disposed as to hinder the free exercise and healthful employment of every muscle and every limb; if it is so exacting that it impedes free breathing, walking, or running—whichever the sex. Skirts should be made the measure of the stride and length of the limb, and the grace of Grecian drapery should be as freely given to the waist as to the skirt.

No dress should touch the ground in walking—even ball dresses are curtailed now-a-days—and those which sweep the floor are only fit for the chambers of the upper ten. Yet one often sees working-girls' dresses trailing on the ground and raking up the dust and dirt and every abomination.

Dr. Jaeger's sanitary woollen system of clothing is destined to work a revolution in modern dress, and its economy is no less remarkable than its efficiency and healthfulness.

If it is essential to the grown person to be free from the trammels of dress, how much more necessary is it for the growing child; the stunted growth of childhood, bandaged up as children are in some countries, is the practical comment on the evil.

As I have said elsewhere, so common a thing as bandiness in children is preventible by good nursing. Is anything more brilliant than the beaming face of an infant when first it finds the use of its legs and feet? How cruel to delay the process by which its nature teaches it to exercise its powers, by hindering its activity for fear of consequences, which can only occur by withholding the means of its enjoyment. Yet the labour of sustaining a child, and helping it by little and little to attain the coveted prize of its first ambition, is shirked by the mother or the careless nurse, till its unhealthy weight (the result of insufficient exercise) brings about a danger which need never have existed. The importance of good nursing in early life is the first of sanitary revelations, and its effective realization the most lasting in its results.

"Scratch the green rind of the sapling or rudely twist it in the soil,
And the gnarled and crooked oak shall tell of thee for centuries to come."

2.—Relative Sanitation.

The limited time at my disposal requires great brevity in treating of the surroundings of the person: in short, the *Home*.

"That fair dwelling furnished wisely with a gentle tenant in it,
This is the glory of Humanity—thou hast seen it seldom."

A.—*Cleanliness of the House.*

In spite of the reputed slovenliness of artists, the studios of the period are models of elegance and cleanliness. The surface *cleanliness* of the house is as important to artistic completeness, as I have defined it, as personal cleanliness. Mr. Aitchison speaks well on this point: "The things we have mainly to guard against in our time are dirt, dust, and the fouling of the air; the street mud we bring in with us, consolidated external and internal soot and dust, and such soft matters that are occasionally dropped about, such as particles of food and the like. Every crack in the floor and skirting gets filled with this, and is liable to putrify when exposed to dust and warmth. Besides the dust in our streets, we make our own dust inside our houses; *particles* from shoes, from wood and stone, from our clothes, oil cloth, mats and carpets, are constantly being worn off and carried for a time in the air, together with the scales of our constantly renewing skin, and as soon as the morning air is overladen, or becomes comparatively still, every thing is covered with light dust, and a great deal of this dust is what the doctors call septic or putrifying dust."

Now all such open joints in wood-work, furniture, and plastering, should be puttied up, or filleted and painted, or var-

nished. All painting and papering can be made innocuous by a good coat of varnish. Smoothness of surface is a great help to cleanliness, and certainly as few ledges and holes for dust as possible, especially if out of reach; under-cut cornices, ornaments, and mouldings, tall bookcases, and cabinet tops are always covered with dust. Then as to woven things, whether of cotton, wool, or silk, the less there are of these the better, and wholly carpeted bedrooms are an abomination.

B.—*Surface Adornment.*

Artistic decoration is gratifying to the senses, and producing cheerfulness in the mind, sustains the body. Bare white-washed walls may be sanitary in a sense, but come very far short of our needs. The Hygienic value of colour is well worth the study, as Mr. White expresses it: "Colour is indispensable to man's happiness and well being, and the senses are as much affected by it as by light and warmth. It is a recognized pathological fact that colour of some sort is indispensable to the healthy condition of the eye, and that the condition of the brain is greatly dependent upon the healthy action of the nerves thus affected. The sensitiveness of the nerves to different colours is shared by the brute creation. By red, these nerves are excited; by green, in like manner, they may be soothed; or they may be rendered torpid by the presence of blue. Yellow, like light, is the colour which most strongly attracts the eye itself. We are affected by black and white in the same sort of way as by darkness and light. Light, in moderation, will produce alertness or wakefulness; in excess, it may produce restlessness or langour by weakening or dissipating the powers. Shade may induce a frame of mind favourable to attention, contemplation, and repose; in excess, it may induce melancholy and depression."

It is undeniable that the human system is thus affected by colour: an artistic side of sanitary science not commonly considered. It is obvious too that the aspect of the dwelling house has much to do with the suitability or otherwise of the colour employed in its decoration. Towards the cold and sunless north, the warmer tints, as red and yellow, must be resorted to. Towards the southern sun, we must oppose the cool shades of blue and grey; and towards the intermediate points of the compass, the greens and browns—the primary tints being sparingly used, and the secondary and tertiary shades being generally employed.

Finally, this is the sum of the matter—It is as inartistic as it is dishonest, insanitary, and false economy, to execute any works with bad materials and workmanship, but especially that of dwelling houses.

It is as inartistic as it is insanitary, to be dirty in our persons or in our dwellings.

It is as inartistic as it is insanitary, to be deformed in our figures, or surrounded by habitations doing violence to every law of geometrical precision and taste in outline and detail.

It is inartistic to be colourless in mind and body, or to be the centre of colourless rooms of furniture.

It is inartistic and insanitary to poison one's skin with cosmetics, or to cover one's walls with arsenical papers and poisonous pigments for painted and coloured decoration.

It is inartistic to dress chiefly for effect and not for useful life, or to clothe one's house with woollens and draperies and dust accumulators and other absorbents, to the prejudice of the purity of the atmosphere in which we live and breathe the largest portion of our lives.

It is as inhospitable as it is inartistic and insanitary, to invite one's friends to dine or to dance in a fœtid atmosphere, where no change of air is possible without draught; or to let your friends sleep in ill ventilated chambers, and perhaps unconsciously, but really (as did the Prince of Wales, at Scarbro'), inhale sewer gases arising from leaky joints of unventilated pipes laid in connection with public sewers.

I say it is as inhospitable as it is inartistic, and most culpably insanitary, to give your friends drinking water drawn from filthy cisterns over which miasma has floated and been absorbed, through the medium of standing wastes in direct untrapped connection with the sewer.

All these things and hundreds more are preventible causes of disease, and yet are commonly done and suffered by peer and peasant alike, through inattention to, or ignorance of, the simplest applications of sanitary science to the every day wants of life, or the absence of any attempt to realise the necessity for its introduction.

For the sake then of "sweetness and light," of "beauty and truth," of health and usefulness and consequent happiness, remember the *Artistic Side of Sanitary Science.*

THE STORY OF BREMONTIER,

And the Reclamation of the Sand-Wastes of Gascony

—

ADDRESS TO THE WORKING CLASSES.

By G. V. Poore, M.D.

In the short address which I have the honour to give to you this evening, I purpose to bring before you the chief facts of a great sanitary work which has been accomplished by our friends and neighbours, the French.

If you will take the map of France and look at that portion of the coast which skirts the Bay of Biscay, you will notice that two great rivers flow into the sea along this coast. One, the most northerly, is the Gironde, a stream which has upon its banks the great commercial City of Bordeaux; the other river is the Adour, the mouth of which is 150 miles south of the mouth of the Gironde.

Between the mouths of these two rivers the shore of the Bay of Biscay is formed absolutely and entirely of sand, and for a considerable distance inland from the coast the soil of France is composed of sand. It is to this great sandy district, covering nearly two millions and a half of acres, and known in France as the Landes or Moorlands, that I wish to direct your attention.

These Moorlands have been the despair of agriculturists for centuries, and have been universally regarded as among the dreariest and most unwholesome districts in Europe. Sand has not the reputation of being a very profitable soil to the agriculturist, and in addition to the natural poverty of the soil the farmer in this region has had to contend with the impossibility of efficient drainage. The Landes formerly produced nothing

except a scant herbage sufficient to support a few miserable sheep, tended by shepherds as ill-favored as their flocks, who generally suffered from one or other of the many diseases prevalent in the country; for disease was about the only crop which the Landes formerly brought forth abundantly.

Indeed, you will find that plains which are unproductive are generally unhealthy. The Campagna round Rome is a very hot bed of malarious and other diseases, and the sandy plains of Holland, and our own Lincolnshire enjoyed a similar evil repute, before efficient drainage was brought about by skilful engineers, and the cultivation of the soil became possible. Husbandry and disease are sworn foes, and the pursuit of agriculture is generally the pursuit of health, and a healthy man is generally contented. Here is an argument for "small holdings," for "three acres and a cow," and for "allotments," which I freely give to those who find pleasure in political contention.

The drainage of the Landes presented special difficulties, and difficulties which no engineering skill and no expenditure of money in the direction of bricks, mortar and machinery, seemed likely to overcome, and for the following reasons:

The reputation of the Bay of Biscay is familiar to every Englishman. It is there, if anywhere, that the force of wind asserts itself, and the winds are generally westerly in direction, and blow with fearful violence from the sea over the land.

The shore of that part of the bay with which I am dealing, is composed as I have said of unmitigated sand. The effect of the wind upon sand is familiar to all of us, for the sand is borne before the wind and travels considerable distances.

Now, in the Bay of Biscay the rise and fall of the tide is great, so that the sand washed up by the sea is left high and dry to the extent of many feet at low water.

Again, in the latitude of the Bay of Biscay the sun is far more powerful than here, so that in the interval between the times of high water the sand is greatly heated by the sun, and is so thoroughly dried that the particles no longer tend to stick together—glued by natural moisture,—but are easily driven before the furious blast which comes roaring from the sea. When the wind is not very strong it blows the sand into heaps along the shore. These heaps or hills may reach an elevation of from 60 to 300 feet, with an inclination of about 30 degrees towards the sea. These heaps of sand are called "dunes," a word having the same origin probably as the English "down," and formerly the whole fore-shore of the Bay of Biscay, between the Gironde and the Adour, presented an undulating appearance, as though a portion of the swelling, rolling sea had

been turned to sand and become stationary. If these sand-hills had been really stationary they would have formed a natural rampart against wind and waves, and it might have been possible to drain and cultivate the land behind them. But this was not the case. The scanty herbage of grass and reed which grew upon the dunes was not enough to fix them. It only required a gale of moderate force to completely alter the face of the country;—hills became flat, valleys were filled up, the lakes which formed behind the dunes became dry land, the water which the lakes contained was forced in some new direction, and what happened to the lakes also happened to the water courses, with the result that the whole country was water-logged, and fields and gardens which had been painfully and industriously cultivated were submerged by the drifting sand. It is even stated that villages disappeared completely in this way, and that the enterprising agriculturist in digging his estate was liable to the surprise of finding just beneath the surface the brazen weather-cock on the steeple of some long forgotten parish church. It is a great labour, even at the present day, to keep the mouths of the Gironde and the Adour free from drifting sand, and it is certain that a century or so ago the course of the Adour was completely changed, owing to the channel getting dammed by sand blown into it. If an accident such as this could happen to a mighty stream like the Adour, one may judge of the great uncertainty which attended the course of smaller streams, and the absolute impossibility of draining the land.

A few feet below the average level of the surface of the district there is an impermeable stratum, locally known as *alios*, which keeps the water from flowing away, and beneath the impermeable stratum is more sand sodden with undrinkable water.

The result of this condition of things naturally was that the district of the Landes during the wet season was a swamp, and during the dry season a pestilential morass. The district was uncultivated, and produced nothing but scanty herbage, which served as pasture for a few wretched sheep, tended by shepherds doomed to spend their lives upon stilts, for the country was such that it was impossible to walk far in any one direction without sinking to the waist or shoulders. The country produced no corn and the population was the scantiest in proportion to acreage of any district in France. The population was kept down also by disease. Fevers of all kinds—and especially those of a malarious type—were exceedingly common. And in addition, there was a disease peculiar to this and a few other districts in Europe, known as Pellagra; a

terrible disease which disfigured and slowly killed; the patient dying with the aspect of a mummy and the mind of an imbecile.

The Landes had remained for centuries as a hideous blemish on the fair face of France, and all attempts to reclaim and cultivate them had signally failed. The Emperor Charlemagne, it is said, employed his troops in the intervals of his Spanish campaigns in an attempt to reclaim the Landes, but the forces of nature laughed at the puny opposition of the greatest magnate of the world, and at once resumed their sway as soon as the imperial soldiers had ceased to dig ditch and throw up bank.

I have no fear of being contradicted, when I say that it is of no use to attempt to fight with Nature. We may oppose her for a time, but only for a time. In the end she asserts her sway, and man sees too late how his labour has been in vain.

Dwellers in these Islands do not need to be reminded of the awful and irresistible power of wind and wave, against which the mere dead weight of cyclopean breakwaters, constructed at gigantic cost and maintained by constant periodic expenditure, is at times laughably impotent. I need not say that the wind and waves of the Bay of Biscay are the roughest and rudest in the world, and that if the maintenance of dead breakwaters is an endless and almost hopeless task on our coasts, on the stretch of coast which I am considering their construction and maintenance would be alike impossible. Thus it was that until the latter end of the last century the condition of the Landes, a tract of two millions and a half of acres, seemed hopeless, and they seemed doomed to be open to the fury of sand storms for ever, and to remain a pestilential, unprofitable, undrained swamp to all eternity.

But, happily for France and especially for the dwellers between the Gironde and the Adour, there was born in 1738 Nicolas Theodore (or Thomas?) Bremontier. It is said that the world knows nothing of its greatest men. Certain it is that Bremontier was one of the greatest benefactors to humanity that the world has ever known, but I regret to say that I can tell you very little about his life.*

* By the kindness of Mr. Jenkins, the Secretary of the Royal Agricultural Society, I have been enabled to obtain from Paris the following extract from the memoirs of the Agricultural Society of the Seine. This short biographical notice of Bremontier is from the 13th volume of the Transactions of the Society (for the year 1810), and has been most courteously extracted by M. Laverriere, the Librarian:

"Nicolas Thomas Bremontier was born at Quavilly, near Rouen, July 30th, 1738, and soon manifested great aptitude for the exact sciences. He was very young when he entered the school of the '*Ponts et Chaussées*,' and at 18 he went to the College of the Marine Artillery at Toulon, to teach applied mathematics. This school, established by M. Choiseul, was broken up a few years later, and Bremontier went as Engineer of Roads and Bridges, first to

Bremontier recognised the fact that the only way to grapple with the forces of Nature is, not to fight blindly with them, but to try to make use of them. Nature is always working for our benefit, and although it seems as though at times in a fit of anger as it were (the real object of which we may fail to comprehend) she destroys much of her own work, still, in the long run, those who endeavour to turn the forces of Nature to account will find the balance enormously in their favour.

It is well known, and has been long recognised, that the best protection for a bank or rampart against the fury of the elements is to plant it. A loose heap of earth is liable (no matter how huge it may be) to be washed and blown away in times of tempest. If, however, the bank be planted, the roots of the trees and plants hold the elements of the soil together, and the spreading branches and leaves form at the same time a protection from the fury of wind and water. It is true that even planted hills and banks may suffer severely in times of exceptional storm, but the storm once past, the

Perigueux, and then to Bordeaux. Here he was actively engaged in his profession, and published papers on the drainage of marshes in the neighbourhood of Bordeaux, on the cleansing of the Bordeaux harbour, and on the methods of restraining rivers and torrents to their proper beds. His energy was inexhaustible, and in his leisure he taught himself the principles of music and became in this direction most efficient. Promoted to be Inspector of Roads and Bridges, he went to Brittany to make a canal to join the Rance to the Villaine. Thence he was sent to Normandy to make a canal from the Orne, by Caen, to the sea. At Caen, he reconciled the differences which had arisen between the provincial magnates and the officers of the Ponts et Chaussées, and his judgment and conciliatory spirit had proved useful in a similar way in Bordeaux. When, therefore, the post of Engineer in Chief for Guienne became vacant, he was appointed in obedience to the wishes of the locality.

"Bremontier joyfully accepted this post, not merely because it was at once a professional and social promotion, but mainly because while formerly living at Bordeaux he had been a witness of great troubles for which he believed he had found a remedy; at least his early experiments (conducted at his own cost) gave him a strong cause for hope. Bremontier felt that here was to be the theatre of his greatest and most useful labours. Possibly, we might believe, he thought to earn an unperishable fame, for self-interest, we are prone to think, is the main spring of good works. Bremontier had less need of such a spur than most men.

"He had visited the sand hills of Gascony during his first sojourn at Bordeaux, and bewailed the misery caused by those moving mountains thrown up by the sea and driven by the west wind, which had already smothered a vast tract of cultivated land, as well as rural inhabitants and villagers, and threatened to cover the more fertile districts and advance even to Bordeaux itself.

"The idea of arresting this devastating power took possession of Bremontier, and the hope of success occupied entirely his brain and hands. He studied the nature and the movements of the sand, he measured their extent, and noted the ravages past and to come.

"He recognised their vegetative power, and from the year 1787, he knew that a great number of plants and especially resinous trees could find nourishment in them. He made experiments at his own cost to get some definite

silent forces of nature commence at once the work of reconstruction; the damaged roots send forth fresh rootlets, the damaged branches soon push again with buds of promise, and possibly before the advent of the next exceptional gale, the storm rampart is stronger than before. These silent forces of nature are truly beneficent; they merely ask for fair play, they work for us without wage, and one great principle of success in all work in this world, be it legislative, be it sanitary, or be it of any other kind, is to go with them, not to fight against them; to learn if we can what is nature's inexorable law, and lay to our hearts the fact that nature brooks neither stubbornness nor disobedience.

Bremontier recognised the fact that the only way to fix the drifting sand-dunes was to plant them: but how and with what? These were the questions he had to solve. Sand is not regarded as a promising soil by agriculturists in general, and the sea-sand along the shore the least promising of all. And yet sand must contain in its interstices a good deal of organic matter left by the seaward-tending rivers, and the fact that the sandy estuaries

facts. He perfected his method of procedure, and at last, certain of success and feeling that such an enterprise was beyond the power of a single man, he sought the help and succour of the Government. His assertions were not credited, and his project shared the fate of many other creations of genius which are repelled at their birth by the ignorant, until the results become so numerous and evident as no longer to be neglected.

"After Bremontier's first attempt the solid basis of procedure was found, and the extension of his work alone was necessary. What proportion was there between the few acres planted at the cost and by the care of one man, and that vast stretch of country extending from the Gironde to the Adour, nearly 180 miles and averaging 3 or 4 in breadth, all exposed to the action of the destructive sand and in part covered by it?

"During his second residence at Bordeaux he renewed his application to Government, this time still more certain of the success of his project.

"In a short notice like this it is not possible to enter into all his trials and difficulties, nor to dilate upon the dangers to which he and his works were alike exposed during the period of anarchy to which France at that time was so long a prey.

"The genius who then controlled the destinies of the Empire appreciated the value of Bremontier's projects, and in the year 1801, he allotted 50,000 francs for the continuance of the work, and a similar sum has been allotted to it in each succeeding year.

"Bremontier now began to enjoy the fruits of his labour, and in 1808, 3,700 hectares of land (about 9,000 acres) had already been sown. Honoured by the esteem of the department of *Ponts et Chaussées*, he had been promoted to the rank of Inspector-General, and he was chosen by his fellow citizens of Bordeaux to be one of a deputation to wait upon the Emperor at Bayonne. He had then the happiness to submit to this great ruler his future projects and his past success, and felt assured that from that time the great work to which he had devoted himself would not be abandoned, and that its future success was assured. The fixation of the whole of the Dunes is now ranked among the great public benefits to which Napoleon with the instinct of a genius gave his support. Bremontier in his dying hours was doubtless consoled by this pleasing prospect, and he breathed his last surrounded by his friends, and with the calmness and resignation of a true philosopher."

of rivers are very liable to breed malaria may be taken as evidence that organic matter must exist in quantity and in fine division among the minute particles of sand. This spring I was astonished at finding, close to Biarritz and within a few yards of the sea, a very flourishing crop of peas which had been sown in the sand without, apparently, the admixture of any manurial body. They were protected from the sea-winds by hurdling made of gorse, and enjoyed an ample exposure to the sun, and thus bid fair to yield a good return in due time. The pea is a plant that sends its roots very deeply, and the roots doubtless found moisture and nourishment at a great depth below the surface. For fixing dunes, however, something more permanent than peas is necessary, and Bremontier resolved to try the Pinus Maritima, a species of pine-tree which was known to flourish in sandy soils near the coast. The Pinus Maritima is a species of Pinaster, and in habit and size it very much resembles the common "Scotch Fir," with which you are all familiar. Bremontier made his first sowings of the seeds of Pinus Maritima in the year 1789, and I will state shortly his perfected manner of procedure by which he overcame the obvious difficulties of his task.

I wonder what the dull-minded and prejudiced peasant thought of this enthusiast who went forth to do battle with the mighty ocean and still mightier wind, armed only with a few handfuls of pine seeds such as might be driven far away by the first strong gust that blew. I wonder also if only the ignorant laughed at him, and if he escaped the jeers and sneers of those who had enjoyed the advantages of a better education. Probably not, and equally probably he cared little for the opinions of the prejudiced. The pine seeds were sown mixed with seeds of the common broom, and the sowings were made in a direction at right angles to the prevailing wind. A screen of hurdles made of gorse or of planks deeply driven into the sand was placed on the windward side of the seed-ground, and the seed-ground itself was thatched with pine branches and other suitable material. At the end of the first year the broom would be 9 or 10 inches high and the pine saplings only 2 or 3 inches, and thus the tender little saplings were nursed and protected by the plants of broom. In half-a-dozen years or so the brooms had reached their full growth, but the pines continued to grow, and, in course of time, overtopping the brooms smothered their nurses, and being themselves judiciously thinned and pruned by the foresters, grew into fine trees able to resist the fury of the elements, sending their long tap-roots and laterals in all directions through the dunes, and causing them to become year by year a stronger and stronger protection to the inland wastes instead of a dangerous menace. Before

the dawn of the present century Bremontier had proved the success of his practice, and in the year 1801 the matter was taken in hand by the French Government, and in 1810 it was ordained that so much of the sand-dunes as belonged to the State should be planted after the manner of Bremontier, while the private property of those who were unwilling or unable to plant should be taken in hand by the State, all revenue arising from such land being confiscated until the cost entailed by the work had been recouped.

In 1817, a yearly sum of less than £4,000 was voted for the reclamation of the dunes and wastes of Gascony, the result of this has been that in the department of Landes, 98,000 acres of forest have been planted, and that whereas in 1834 there were about 900,000 acres of uncultivable land in the department of Landes alone, there are now only 340,000 acres, showing that in the past half century, reclamation has proceeded at the rate of 12,000 acres a year. These figures apply only to the department of the "Landes," and leave out of consideration the department of "la Gironde," in which, however, nearly half these waste Moorlands are situated. This reclamation has been made possible by the fixation of the dunes, which has rendered systematic drainage operations practicable; canals and drains have been cut in every direction, and, thanks to the pine forests, there is now no longer any risk of their being choked up with sand.

The Pinus Maritima has proved a very profitable tree, and within twenty or twenty-five years of sowing, it began to yield a return. The timber is of very moderate quality, but is largely used for packing cases, as shores in the dockyards of Bordeaux, for railway sleepers, and for fire-wood. I may remark in passing, that the great scarcity of coal in France compels the French to look to their forests for fuel, and there is probably no nation more clever and more thrifty in the management of trees.

The pine trees are chiefly valuable for their yield of turpentine and resin, which in that comparatively warm climate is very abundant. The resin is obtained by removing a strip of bark from the tree and allowing the exuding sap to trickle into a small earthen vessel shaped like a flower-pot. The trees begin to yield resin when they are about twenty years old, and the resin is worth about £5 a hogshead in its raw crude condition. As far as I am able to judge, it requires about 250 trees on an acre of ground to give a hogshead of resin. It requires comparatively little labour to collect the resin, so that the profit per acre from the resin harvest is considerable. It is said that the draining away of the resin does not seriously

affect the value of the timber. Besides resin and timber, the manufacture of charcoal is largely carried on, charcoal, as you are aware, being in great demand in France for a variety of purposes.

Thus it appears that the waste moorlands on the shores of the Bay of Biscay have become of great commercial value. Journeying from Bordeaux to Bayonne the railway passes through one long monotonous pine forest. When I state that the journey takes between four and five hours you will be able to judge of the vast tract of country which, once the abomination of desolations, is now covered with millions of the resin yielding Pinus Maritima. The cultivation of the pine improves the soil, which is gradually enriched and altered in quality by the dead leaves and other vegetable *debris* which fall upon it. In some places clearings have been made in the forest and vineyards planted, and I need not remind you that the most valuable vineyards in the world are on the southern bank of the Gironde on the very fringe of the pine woods which I have been describing.

The rise in agricultural value of this tract of country, great as it is, is a small matter. The great gain after all has been the rendering wholesome of a pestilential swamp and the removal of a plague spot from the face of Nature. The Shepherds of the Landes, except in very few places, have now no longer any need to walk about on stilts, and Malaria and Pellagra from being common have become rarities, and will soon become extinct. Life in this district no longer languishes and ends prematurely, but the dwellers of this vast district enjoy a vigorous health, and that happiness and contentment which vigorous health alone can give.

Population has increased very rapidly since the beginning of the century, and industries of various kinds are able to be carried on. Round the basin of Arcachon is a very large population supported mainly by the oyster fisheries, and the town of Arcachon which has grown up in the pine forest is one of the best known health resorts in Europe, where land in the best situations is worth about £1,000 an acre. Well may the dwellers in Arcachon raise a statue to Bremontier, whose far-seeing and thrifty policy has brought them health, happiness and riches in place of disease, misery and poverty.

I have now given you the simple details of the manner in which Bremontier's small beginning has made great end; how his pine plantation, made at first with no little labour and sorrow, began along the coast, and with the lapse of a century has reclaimed a province.

You will be asking, perhaps, why I have chosen this subject

for my short address to the inhabitants of York, and having listened to my tale, you will be asking for the moral.

I chose this subject for my address for several reasons. The chief reason probably is to be found in the fact that I spent part of the early spring of this year in the district which I have been describing, and what I saw there made, as it could not help doing, a very deep impression upon me.

My next reason was that it is an aspect of sanitation which is not often dealt with at meetings like this, and I was glad of the opportunity of taking you away from pipes, traps, sinks, and those expensive roads to health which we have to consider in cities, to contemplate the sanitary effect of good husbandry in the open-air; and to show you on a large scale what I believe to be universally true, viz., that the cultivator of the soil must always be the right-hand man of the sanitarian.

It has been refreshing for us to contemplate a sanitary work which has been a financial success. Sanitation always gives us the best of all dividends—health. And it is a short-sighted policy, especially in cities, to look for a money return on the capital expended on works for improving the public health. The thrifty French, however, have given to the world a valuable example of a comparatively small expenditure yielding *in the course of time* a magnificent return of both health and material prosperity.

Do not run away with the idea that the Pinus Maritima is a cure for all waste lands, and unwholesome districts, because it happens to be especially suited for the soil and climate of the eastern shores of the Bay of Biscay. In the warm climate of the south it yields abundance of resin and turpentine, grows quickly, and furnishes a large quantity of timber. In more northern climates it will grow, but does not flourish; and although there is at least one fine specimen in Kew Gardens, it is not, from all I have heard, a tree suited to this climate.

My story seems to show that in the reclamation of waste lands we must not be in a hurry. Nature is sure, but from our point of view, slow. Bremontier, and those who worked with him, began in a small way. We may be sure that experience had to be bought at more or less expense, and it was not until the success of his methods had been proved that the French Government seriously took the matter in hand. Bremontier was a true patriot. He worked solely for the good of his country and for posterity. He had no idea of immediate profit, either for himself or his contemporaries. He drew his modest salary as inspector general of roads and bridges (for he was an official of the state department of "*Ponts et Chaussées*), but looked to no further profit. He lived barely long enough to see

the resin flow from his first plantings. He pointed out, as it were, the way to the promised land, but, for himself, he only saw the promised land "in his mind's eye." It is good for us to bear this fact in mind, for many reformers of the present day seem, in questions of land management, to look only for immediate results, and to be actuated by the not very noble sentiment of "bother posterity, what has posterity done for me?"

There has been a good deal of talk of late about the reclamation of waste lands in this country, and the opinion of some seems to be that worthless soil presents a glorious opportunity of wasting money. These are questions concerning which I cannot speak to you as an expert, but it seems certain that the problem of reclamation must differ with the circumstances of soil and situation, and that it is far more easy to do the wrong thing than the right. The first thing necessary is to find a Bremontier to show the way. We shall want a Bremontier to show us the way out of the pestilential quagmire which we Londoners are making by dint of large expenditure in the estuary of the Thames. We want a genius and enthusiast who will do for the bogs of Ireland what this great Frenchman did for the Landes of Gascony.*

* For many of the facts embodied in this address I am indebted to Dr. John Croumbie Brown's "Pine Plantations on the Sand-wastes of France." Edinburgh (Oliver and Boyd, 1878).

THE SUPPLY OF WATER TO TOWNS.

ADDRESS TO WORKING CLASSES.

By James Mansergh,

MEMBER OF COUNCIL OF THE INSTITUTION OF CIVIL ENGINEERS.

I propose to devote the time allotted to me this evening to the subject of water supply generally, illustrating my remarks by a short description of the works furnishing water to the inhabitants of this City of York.

When I was a boy my ideas with regard to the sources of water for domestic use were naturally derived from the experience of those early days.

In the yard adjoining my father's house was a pump, and I was told that it stood over a well which had been dug into the ground to a certain depth at which water was found.

All our neighbours in the town obtained their water by a similar contrivance, and when I went a little way into the country I found there were wells open to the surface without pumps, and from which the water was drawn up in a bucket by means of a rope. I could see the water when I looked down the well. No further explanation being forthcoming, I naturally concluded that below ground there was universally distributed a store of water, into which it was only necessary to sink a well and lower a bucket to obtain as much as was wanted.

I have reason to believe that in those days my conceptions of the underground reservoir were shared by many of my elders and betters, and, as it may be that some now before me have even now no very clear notions on the subject, I will try and throw some light upon it.

It is estimated that about five-sevenths of the whole area of the earth's surface is covered with water, either the salt water of the oceans and seas, or the fresh water of inland lakes.

Now from this enormous area of something like 145,000,000 square miles, the sun is always drawing up the water in the shape of invisible vapour into the atmosphere by the process of

evaporation, and the air in this country usually contains about 1½ per cent. of this aqueous vapour.

The warmer the air the more capable is it of absorbing and holding moisture, and the greater the quantity held the lighter becomes the air. From water surfaces the amount of evaporation is on the average about equal to the rainfall; in cold climates it is probably somewhat less, and in hot climates somewhat more.

The Dead Sea in Palestine has no known outlet, yet the waters of the River Jordan are constantly pouring into it without raising its level, which is 1,300 feet below the Mediterranean. What the river pours in the sun regularly pumps out.

Again, the Mediterranean itself is another notable example of the enormous quantities of water constantly being taken up into the air, for notwithstanding the volumes delivered into it and the inland seas connected with it by the larger rivers, such as the Rhone, the Po, the Danube, the Dnieper, the Don, and the Nile, this is insufficient to make up for the evaporation, as it is found that almost at all times the current is setting inwards from the Atlantic through the Straits of Gibraltar.

From the land moistened by rain evaporation also goes on, until after a season of drought there is practically nothing more to take up, and its amount varies very much according to the character and configuration of the surface.

Now let us see what becomes of all this water so taken up into the air. A quite familiar illustration will suffice to tell us. Suppose you are sitting in a warm room on a winter's night with lights burning, the air will from several sources become charged with moisture, in the same way as is that passing over the sun-warmed surface of the ocean. The glass of the windows is kept cool by contact with the cold air outside, and you will find that inside it is covered with a thick misty film, forming possibly in places into decided streams running down to the frame. This, as you are all aware, is the result of condensation. The warm air of the room in circulating about comes against the cold glass, is cooled, and thus made incapable of holding as much moisture as before, and therefore deposits it upon the window.

This is just what happens when warm saturated air meets with a current of cooler air, as frequently occurs when warm winds, blowing across the sea, touch the land. The invisible aqueous vapour is first condensed into mist, forming clouds, and when still further chilled aggregates into drops and falls to the ground in the shape of rain, and under suitable conditions as snow or hail.

In this country the prevailing wind is from the south-west, and brings the moisture-charged air from the Atlantic. It is

not surprising, therefore, that on the west and south coasts there is more rain on the average of years than on the east. My friend Mr. Symons has shown this very clearly on what he calls a Hyetographical Map, a copy of which he has been good enough to allow me to show you.

Those parts of the country where it has been found from long series of observations that the least rain falls, are coloured a very light blue. This is, broadly speaking, along the east coast, and forms a zone in which the average annual rainfall is less than 25 inches. Then another zone in which it ranges between 25 and 30 inches, is coloured a slightly darker blue. Between 30 and 40 darker still, and so on in succession until the heaviest falls are reached near the coasts of Wales, Cumberland, and the West of Scotland, being over 75 inches.

Where the land is the highest the rainfall is the greatest; this is natural, because the mountains rear their cold heads up into the air and act as condensers. The darkest coloured spots are therefore in Cumberland and North Wales. Some of you may possibly have noticed in this country with what persistence a cloud sometimes seems to hang about at the top of a mountain you have wanted to ascend. On the isolated elevated peaks of the Alps, even when the wind may be blowing strongly, this is often seen in a peculiarly interesting shape. The sky all around may be bright and clear, excepting just on the lee side of such a peak, where a little cloud may be seen apparently attached like a fluttering grey flag. The wind brings up the warm moist air; immediately it touches the chill summit the moisture is condensed, and passes on some little distance to leeward as visible vapour, but is soon re-absorbed and lost to view, as it gets beyond the influence of the condenser. This is therefore not a stationary cloud, but one which is constantly being formed and as constantly being destroyed. The wind keeps bringing up the moisture-charged, but invisible air, and the mountain top condenses it temporarily in passing. In these cases the condensation is only carried to the extent of creating mist or fog.

On a summer evening you often see mist apparently rising from the surface of low-lying land; this is really only due to the condensation of the vapour in the warm air by the cooling ground.

The dew upon the grass, the moisture upon your window, the cloud upon the mountain-top, and the showers which water the earth, are all the results of condensation, and condensation is due to differences of temperature.

Many years ago on a voyage to Brazil in the old "Great Western" we stopped to coal at St. Vincent, one of the Cape de Verde Islands, a bare sand rock, with scarcely a trace of vegetation, and we were told that they had not had a drop of rain

for over a year. This pitiable condition was due I presume to the fact that the island had, during that period, never got sufficiently cool to act as a condenser.

Now let us see what becomes of the rain after it has fallen upon those parts of the earth—for example, our own island—which are fortunate enough to get it in sufficient quantity, and with fair regularity. This depends—as by a moment's consideration you will realise—upon the nature, shape, and material, of the surface upon which it falls. If upon the steep slated roof of a house it runs rapidly down to the eaves' gutters, and from them by the downspouts more rapidly still to the ground, or the drains. Thence it passes into a stream or river, and so on ultimately to the ocean, whence it came. When the rain ceases the roof soon dries, because there are no hollow places where the water can lodge, and there is no percolation through the slates into the house. The rain that falls upon a paved street does not get away so rapidly as from the roof. First, because it is not so steep, and second, because there are slight hollows at the joints and other places where the water lodges and remains. Most of it runs off by the gutters, but some of it is evaporated and some of it may sink into the ground.

In these two cases the behaviour of the rain depends principally upon the artificial circumstances of the surfaces, and examples might be multiplied of many various divergencies from simple natural conditions; but it is not necessary that I should particularise them, and I will pass on to consider what happens in open country.

A few examples will suffice to mark the differences.

Take first such a district as that popularly known as "the Lakes" in Cumberland and Westmoreland. There the hills are formed in great part of hard unfissured rock, into which the rain cannot percolate, principally because of its density, and partly because the slopes are steep and the water runs off rapidly into the watercourses and rivers and on to the sea without much appreciable diminution in volume. Some loss of course there is by evaporation. If the rocks were absolutely bare, quite impervious, and as steep as a house roof, it would of course be very small indeed, but this is rarely the case. More frequently a great part of the surface is covered with either a thin layer of disintegrated rock or gravel into which some of the rain percolates, or with turf or other vegetable growth which absorbs part and holds another part until it is evaporated. It has been estimated that from such a district from 7 to 10 inches of the annual rainfall is thus accounted for, which would be about one-eighth of the average annual fall.

It is interesting to point out here that such a map as Mr.

Symons, before referred to, is almost certain to indicate at a glance two things in addition to what it actually professes to show; that is to say, wherever you notice the darkest blue patches you may rightly conclude, 1st, that they mark lands of high elevation; and, 2nd, that these lands consist of rocks which have maintained their altitude because of their hardness and power of resisting the wearing down, or, as geologists call it, the degrading influences of air and wind, rain and frost.

Now compare this lake country with the chalk downs of the south of England. In many places these are fairly steep, and the water would pass off quickly, but for the extreme porosity or easy permeability of the subsoil. Generally the downs are covered by only two or three inches of soil and fine grassed turf offering a slight obstacle to the free percolation of the rain into the chalk below; and, as a matter of fact, there are no surface streams in the higher parts of a chalk country.

As in the former case, absorption by and evaporation from the vegetable covering take place, and water held by capillary attraction in the upper part of the subsoil is also drawn up by the sun and air and evaporated; but there is here the essential difference that a large percentage of the rainfall passes away out of sight into the ground, part of which is absorbed into the mass of the chalk, and the rest runs through fissures and among flint veins to some natural or artificial outlet at a lower level. On the south coast the water may be seen running out of the base of the chalk cliffs and meandering through the shingle beach to the sea. Inland it appears in the shape of strong springs, as at Croydon and Carshalton, where they go to form the river Wandle, a short tributary falling into the Thames at Wandsworth.

In the London basin a good deal of the rain falling upon the chalk-outcrops to the north and south, passes under the tertiaries, and is recovered by means of wells sunk through the impervious overlying beds and pumped up for domestic and trade purposes.

In the case of my native town above referred to, the circumstances were these. The upper strata for 10 to 20 feet in depth consisted of porous sand or gravel, into which the rain percolated until it was stopped by a bed of impervious clay upon which the gravel rested. This formed the bottom of an underground reservoir, and if a well were sunk down to the clay and lined with open jointed brickwork or rubble, the water soaked through from the gravel, and could be obtained by means of the pump. It is evident however that this reservoir could not be inexhaustible. Such a store is merely a bank. If a man puts £100 into his credit, he can at his convenience draw

out ten instalments of £10 each, but he cannot draw more without again replenishing his credit.

This case of my own youthful experience, so far as it was utilized, was one of the simplest that can occur. The wells were all shallow, the clay-bed was for all practical purposes the bottom of the reservoir and the quantity of water it would hold was strictly limited, and each well only lasted out a few months in time of drought. Under other geological conditions the quantity of water yielded by a well may be increased by deepening it, as would be the case in the water-bearing part of the chalk by enlarging the area from which the water would be drawn; for the well must be regarded as the apex of an inverted cone, towards which, when pumping is going on, the water gravitates as it were down its sloping sides. The lower, therefore, the well is sunk the larger will become the cone which can be exhausted by pumping. Or a well may be made more productive in a district consisting of interstratified beds of pervious and impervious material by sinking through one of the impervious beds which for the time being has formed the bottom of the well into a pervious or water-carrying bed below, this bed having in one direction or other an outcrop exposed to the surface where the rain can fall upon and charge it. Varied, however, much as the conditions may be in different localities the fact remains that the quantity of water obtainable from underground sources depends entirely upon the amount of rain which gets into them. Thus, if it were to happen here as it does in the island I have mentioned, that it did not rain at all for a whole year, probably every one of the hundreds of wells drawing water from the chalk in London would be exhausted.

Referring again to the old pump at home, I need hardly say that it has long since been abolished with all its fellows and replaced by a public supply distributed by pipes under pressure, such as now exists in the great majority of the towns of this country. This change has come about partly on account of the great convenience of the modern system, but principally because of the evils resulting from the old state of things.

Thus within a few yards of our family pump was also the family privy, and when in later years I began to realise the fact that between the privy pit and the well, there was the freest intercommunication through the open gravelly subsoil, my sensations were not of the pleasantest. Now-a-days it makes me shudder to think of the abominable conditions under which the whole community was living, and I can understand why the death-rate at that time was over 30 in a thousand. The town was not a large one, but I now know that from 150 to 200 persons died every year on account of this charmingly simple circulating

system of sewage disposal and water-supply. The fittest only survived the treatment.

The reform that took place in my native town thirty years ago has been repeated in hundreds of others, but the sort of works has had to be varied in each case according to the local topographical and geological conditions of its neighbourhood. I will refer shortly to a few of these different types.

First, however, it must be understood that in any public system of supply, where the water has to be conducted through many miles of street mains and house service pipes, it is necessary that there should be some initial propelling force to overcome the friction, and to raise the water to the varying levels of the district and to the upper floors of houses. This pressure is usually obtained by commencing the main distributing pipe in a reservoir placed at a sufficient altitude, or, in exceptional cases, in pumping continuously into the mains by means of steam or other machinery.

The reservoir is the preferable and almost universal arrangement, as it not only furnishes the pressure, but it provides a store or reserve of two or three days' consumption as a safeguard against accidental interferences with the means of supply beyond itself, and it is called the service reservoir, because whatever may be the original source from which the water is obtained, it must first be delivered into this reservoir before it can be "served out" or distributed to consumers in the town.

There are two great divisions under which all sources of water supply may be classed, viz:—"above-ground" and "under-ground" sources. We have already seen that of the rain falling upon the earth, one part is re-evaporated; a second part runs over the surface, forming streams, rivers, and lakes; and a third part percolates below the surface into the ground, either where its mass is pervious, or by way of interstices, or open cracks and fissures.

The second part replenishes above-ground sources, and the third part under-ground sources.

Some towns are so situated that the water for their supply can be taken from above ground, that is from a river or natural lake, within a reasonable distance, and at a sufficient altitude to flow by gravitation into their service reservoirs. Other towns may be so located that water can be obtained also by gravitation, but where it may be necessary to collect the water from a given watershed or drainage area into reservoirs artificially constructed to contain it; because, first, no natural lakes exist; and, second, though there may be small rivers or streams they are not large enough in dry summer weather to furnish the quantity the towns may require.

These are called storage or impounding reservoirs, and they have been constructed in large numbers by damming up the valleys on both sides of the Pennine range of hills, for the supply of water to the manufacturing towns of Lancashire and the West Riding of Yorkshire.

Again, towns situated like York, upon such a river as the Ouse, but not much above sea level, can obtain an ample supply without the necessity of making storage reservoirs—because the river is large enough at all times to meet the demand upon it; but to set against this they have to incur the cost of pumping the water up into the service reservoirs, in order to provide the necessary pressure for distributing purposes. It will thus be seen that "above-ground" or surface water supplies are again sub-divided into what are known as "gravitation" and "pumping" works.

Under-ground water, on the other hand, almost universally requires pumping works. There are a few cases in which water, after passing for a distance under-ground, reappears in the shape of springs at a sufficient elevation to supply the service reservoirs of some fortunate towns, but as a rule under-ground water has to be recovered by the sinking of wells and the use of pumping machinery. In this country the chalk and the new red sandstone are the largest sources of under-ground water supplies, but there are also many wells in the oolites, mountain limestone, and other water-bearing strata.

Now let us say a few words on the different qualities of water, for you are all aware that waters may differ in various ways, as much as many manufactured articles. During the first stages of its formation, viz., evaporation and condensation, all water is practically alike pure; but even whilst still in the air, and before it has reached the ground in the shape of rain and snow, its quality is affected by dust and smoke, which you can easily see, and by the more finely divided particles always floating about in the atmosphere, but which you cannot see, excepting in a bright beam of light in an otherwise darkened room. A striking illustration of the relative deterioration which takes place by mere contact with the air in different situations is to be found in snow. In the middle of a large town its virgin purity of whiteness is dimmed in a few hours, but out on the open mountains it is retained for days unimpaired, simply because the air is cleaner in the one place than in the other.

By flowing over the surface of the ground the water which reaches the earth bright and clear rapidly becomes affected, as can be seen in any country stream after a few hours' heavy rain. It then rushes along muddy and turbid, and varying in colour according to the geological character of every district. This,

of course, arises from the fact that in flowing over the land the thousands of little rills which go to form the stream, abrade or rub off the surface of the soil, carrying away its particles in suspension. Thus, in a district such as the neighbourhood of Cardiff, in South Wales, where the marls of the old red sandstone prevail, the flooded streams are of a bright brownish red colour. In parts of Sussex, in the Hastings sand country, the streams are always more or less turbid and grey, on account of the fineness of the material and the ease with which it is washed off the ground. Then, again, we are all familiar with the colour of the streams flowing from peat mosses both in low-land and hill districts, a water which, when seen in a deep reservoir, is apparently the colour of strong coffee or porter.

In addition to these impurities which we can see, water which passes slowly underground through the various rocks, such as chalk or limestone, actually dissolves and carries away parts of them in an invisible form. Thus, a chemist will tell you that a water as bright as crystal may contain, by analysis, 20 or 50 grains of some salt of lime in every gallon. Although you cannot see this, you can readily feel it, for the presence of dissolved lime imparts to a water the character of hardness, and if you attempt to wash your hands in it you will find it impossible without the aid of a very large quantity of soap.

On the contrary, water obtained from springs in such a formation as millstone grit is nearly perfectly soft, and a bath in it is almost like bathing in oil, and you can clean the skin readily without the use of soap. The difference arises from the fact that the chalk is readily soluble by the water, because it always contains some carbonic acid taken from the air, and the millstone grit is a silicious rock not easily dissolved.

In certain parts of the earth, waters are found which, having become impregnated with sulphur or iron, or magnesia, through coming in contact with rocks containing these substances, are used for medicinal purposes, and have led to the establishment of spas such as Bath, Harrowgate and Malvern in this country, and of Carlsbad, and others well known on the Continent. At some of these the water issues from the ground at an abnormally high temperature, and in the district recently desolated by earthquakes and volcanic eruption in New Zealand, fountains of boiling water are scattered over a large area. Here the ejected water, highly charged with silicic acid, has in the course of ages, formed a series of terraces, some brilliantly white and others a delicate pink, which are most beautiful objects, and have been spoken of as the eighth wonder of the world. It is feared that these have been destroyed by the recent catastrophe.

In addition to these various ways in which the character of a water may be altered after it has reached the earth by taking up mineral matters both into suspension and solution, its quality may also be impaired by contact with organic matter both of vegetable and animal origin. About the vegetable little need be said, because for all practical purposes it is quite harmless. The most familiar illustration of its presence is the colour, before referred to, imparted by peat, which may when not present in great excess be entirely disregarded.

The contamination which is really and seriously objectionable is that produced by the excreta of animals, especially of man himself. Water obtained from rivers would therefore naturally fall under suspicion, because these are the main drains of the country and receive the washings of manured lands and the sewage of the towns. The danger is however much mitigated by a beneficent provision of nature, viz., the process of oxidation. The noxious substances forming animal excreta are generally speaking held together very feebly by their chemical affinities, and the free oxygen contained in running water attacks them immediately it comes into contact with them, and speedily and absolutely transmutes the great bulk of them into inert and quite harmless compounds. It is now thought that minute living organisms play an important part in this operation. That such a conversion takes place has been proved by thousands of chemical analyses, and it is demonstrated by the evidence of our senses, and the very fact of the continued existence of many of our rivers in practically the same condition for generations. In very populous manufacturing districts, however, where the town populations are generally congregated along the banks of the rivers the most serious pollution takes place, both from sewage and trade refuse, so much so as to render the water totally unfit for human consumption. In these districts impounding reservoirs have almost universally been constructed among the hills, and water suitable both for domestic and manufacturing purposes has thus been obtained.

London, the largest city in the world, still obtains 87 per cent. of its supply from the Rivers Thames and Lea, and its acknowledged position as the healthiest large city in the world, goes far to prove that the water cannot possibly be anything but safe and wholesome. It is only right, however, to point out that during the last twenty years most of the towns situated upon the banks of these rivers have, under pressure of the law, ceased to discharge crude sewage into them, and have carried out works for its interception and treatment upon land, or by some chemical process, so as to render it practically harmless. But for this fact, and the improvements

simultaneously effected in their settling and filtering appliances by the Water Companies, the supply to London would by this time have been greatly discredited, and public opinion woul have demanded its supersession. Now, the reports of all the chemists who are constantly examining it, prove conclusively that the quality of the water, as delivered to the consumers, is steadily improving rather than deteriorating. In passing, I may say that these examinations are becoming more interesting every year, as scientific men devise new methods, and it would appear as if we were now opening out quite a new epoch by the device for localising, enumerating, and classifying the minute living organisms which exist in all waters, and are known by the name of bacteria. So far as these researches have already gone, it is comforting to learn that whilst a few individuals may occasionally be found which are injurious, the immense majority are not only harmless but positively beneficial in a water containing them, and, moreover, some authorities contend that it is the function of the harmless creatures to devour and exterminate the harmful.

After these few desultory remarks, which have only just touched the main points of the general subject, let us for a few minutes see how they apply to the waterworks of York, some particulars of which have been kindly furnished to me by the Secretary, Mr. J. D. Watson. The first works of public supply for the city were established in the year 1682, at the Lendal Tower, adjoining Lendal Bridge, the water being pumped from the river by two horses, and distributed through pipes formed of bored-out trunks of trees. About 1790 a steam engine was erected at the same spot, and in 1799 the works—which up to that time had belonged to a family of the name of Thornton—were sold to a Company, who raised the tower and effected other improvements. They had then an engine of 18 h.p., capable of pumping something over 200,000 gallons in twelve hours. Half the city was supplied for two hours on Mondays, Wednesdays, and Fridays, and the other half on Tuesdays, Thursdays, and Saturdays. At the beginning of this century only 1500 families took water from these works, many others obtaining it from water carts at a penny a bucket, or about a £ per 1000 gallons. Between 1800 and 1810 iron pipes were first laid to replace the "old trees." At that time no attempt was made to filter the water. In 1846 a new company was formed, under an Act of Parliament, with a capital of £80,000, who purchased the old undertaking, and established new works on the present site, at a point about a mile and a half above Lendal Bridge, under the advice of the late Mr. James Simpson, Civil Engineer, of London. In 1876,

further Parliamentary powers were obtained, and the works were enlarged for the Company by Messrs. T. and C. Hawksley. The drainage area of the river down to the point of intake is over 1200 square miles, and embraces the watersheds of the Swale, the Ure, and the Nidd with their numerous tributaries. It extends nearly sixty miles in a north-westerly direction from York, and rises up to 2320 feet above the sea at its highest point, near Kirkby Stephen; along its western and northern boundaries the elevation averages 1230 feet, and at its most easterly point it is only 39 feet.

Covering so large a tract of country from west to east, and varying so greatly in elevation, we may expect to find a marked difference in the rainfall; and this is the fact, for near the western ridge it amounts to 60 inches, and at York itself is under 27 inches per annum. Probably, the average annual rainfall over the whole area will approximate to 32 inches. It is not easy to estimate how much of this will run off by the rivers, but between 30 and 50 per cent. will be re-evaporated, and some will percolate into the ground and be lost, so far as the river is concerned. The extent of the watershed area ensures, however, that there will always be a sufficient supply for the population to be served without the necessity of constructing impounding and storage reservoirs. I should expect that in times of the severest drought the flow in the river past the waterworks will never be less than 100 million gallons a day, which is 40 times as much as York now needs.

The watershed area varies not only in elevation and rainfall, but very considerably in its geological formation. Proceeding from east to west, it embraces middle and lower oolite, lias, new red sandstone, magnesian limestone, lower red sandstone, millstone grit, Yoredale rocks, and mountain limestone. From the millstone grit and some of the red sandstone the water will be soft, but there is evidently a considerable area—at all events where percolation largely takes place—of limestone and other such rocks, for the mixed water as it reaches York has a hardness of 12 to 13 degrees on Clarke's scale; that is, it contains nearly 13 grains of carbonate of lime, or its equivalent in every gallon, and it must therefore be classed as a somewhat hard water. This, although probably no drawback for drinking, is undoubtedly disadvantageous for washing, manufacturing, and, I believe, cooking purposes. At Lancaster, in the adjoining county, the water is obtained entirely from springs in the millstone grit, and its hardness is only about one degree, and consequently the quantity of soap required there will be only a fraction of what is needed by a similar number of people in York. Possibly this is not an unmixed advantage.

The rivers draining the watershed flow principally through an agricultural district, and are not polluted by manufacturing refuse, like the Aire and Calder in neighbouring valleys, and there are no large towns upon them from which they are fouled by sewage. Borobridge, a town of 5,000 inhabitants, is the nearest, being situated upon the river Ure, about twenty miles above York. In all ordinary times any polluting matter which passes into the river there will have disappeared by oxidation long before it reaches the point of intake. Analyses prove that, so far as chemists can judge, the water is delivered in the city pure and wholesome.

In the higher portions of the watershed area there are patches of peaty land, and therefore it occasionally happens in the autumn that the water comes down with the characteristic peat stain, but to an extent which is quite immaterial.

At the works the water is taken into three subsiding reservoirs, holding together 6,800,000 gallons, or three days' supply, in which the heavier suspended matters are deposited, and then passes on to the filter beds which have an area of nearly 10,000 square yards, and are formed in the usual way of gravel and sand, and which remove all traces of turbidity and leave the water bright and practically colourless.

After filtration it is pumped through a 21 inch cast iron pipe up to the service reservoir at Severns Hill, a height of 110 feet above summer river level, and for some time each day over a stand pipe 20 feet higher. From this elevation the pressure is sufficient to force the water through all the mains which distribute it in the city, and to deliver it into all the houses where it can be drawn in abundance by simply turning a tap. By these arrangements half-a-ton of water is now supplied at the price of a bucketful a generation or two ago.

As delivered into your houses you may take it for granted that the water is clean and pure and wholesome, but care must be exercised to prevent its being fouled after delivery and before use. Householders as a rule are very neglectful in this respect. In London many districts receive only an intermittent supply, and therefore it is necessary to have cisterns to store during, say twenty-two hours each day, the water that is delivered in two.

Now I have come across many people living in good houses who have not the faintest idea of the condition of this cistern or even knew where it is. From year end to year end it has remained uncleaned and become the receptacle for dust and dirt, dead birds, dead mice and crawling creatures of all kinds. Frequently too, the cistern is situated in an unventilated and nearly inaccessible attic, and its overflow pipe is connected

direct with the house drain, and therefore leads the gases from the sewers right up into the water. The thoughtlessness of educated people about this matter is utterly disgraceful. I am glad to know that in York your supply is constant, and cisterns are therefore not generally required, but it behoves every head of a family to acquaint himself with the details of all the internal water and drainage arrangements of his house and to assure himself for the sake of his wife and children that neither the water they drink nor the air they breathe is in any way contaminated by causes within his own control.

In conclusion, I wish for two minutes to call your special attention to the usefulness of adopting a regular and systematic course of water drinking as a preservative of health.

I believe there exists very largely a quite erroneous impression on this subject, and in consequence many people are in the habit of drinking too little. I believe that every adult person, especially if past middle age, should drink three to four pints of pure water every day, for the purpose of dissolving and removing from the system the products of disassimilation and waste. If this is not done accumulations of crystalline matters are apt to take place in the organs, producing disease of the most painful and distressing character. Having been myself a sufferer, I am anxious that my experience may be useful to others, especially as it has already been confirmed by the testimony of large numbers. The drinking should be done systematically, viz., on an empty stomach at least one hour before a meal, and very little fluid should be taken whilst eating solid food. By preference the water should be hot, that is to say, over 130° Fahrenheit. Hot water thus taken is most useful in curing indigestion, and indigestion, in my opinion, is at the root of many of our more serious bodily ailments. I cannot now go into further details, but I feel that it is not inappropriate in dealing with my subject to-night, under the auspices of a society having the improvement of the health of the people for its object, to refer thus shortly to a remedy so simple and yet so efficacious.

To all those who have the cause of Temperance at heart—of whom I hope we have a large majority in this room to-night—it will be interesting to learn that systematic hot water drinking has been proved in America to be destructive to the appetite for alcohol, and I myself have heard of cases within the last few months of men losing the desire for their grog at bedtime after a few weeks of hot water.

CLOSING GENERAL MEETING OF THE CONGRESS.

THE closing General Meeting of the Congress was held on the afternoon of Friday, September 24th, at the close of the Sectional Meetings. The President, Sir T. Spencer Wells, Bart., took the Chair, supported by the Lord Mayor and other members of the Local Committee, and the Chairman and Council of the Institute.

The Secretary reported that 150 Members of the Institute had been present during the Congress, and that 250 tickets had also been taken by Associates of the Congress.

Votes of thanks were passed to the President, the Local Committee, the Judges and others who had been engaged in the work of the Congress and Exhibition.

The following reports upon the subjects brought forward for consideration at the Sectional Meetings were read by the Senior Secretaries of the respective Sections.

SECTION I.—SANITARY SCIENCE AND PREVENTIVE MEDICINE.

I have to report that in Section I. the proceedings commenced by the President, Professor de Chaumont, delivering a discourse which placed the Section at once in possession of the facts of our present position as to the causation of disease, and marked the standpoints from which the papers to be submitted might be most profitably considered. The question of Cremation, raised by Mr. William Eassie, C.E., and by Mr. Wilson Robinson, F.L.S., and in which you yourself, Sir, take such great interest, evoked an amount of kindly criticism from ecclesiastics, engineers, chemists, and other authorities, so that Cremation may now be said to have entered the more popular field of public discussion and opinion in this great county of Yorkshire. The temperate manner in which its merits and demerits were discussed is an augury of the impartial mind with which it will be received by the people of the "North Countrie."

The Conference of Medical Officers of Health, which formed part

of this Section, considered the position of the Medical Officer with reference to his appointment, tenure of office, qualification for the post, and his primary duty,—viz., that of controlling infectious disease. These questions were raised in papers by Dr. Bruce Low, Dr. Edward Seaton, Mr. F. Vacher, and myself. That we as Health Officers have still much to learn, was keenly appreciated; but those coming from various populous centres had also much to impart. This Conference will not have been held in vain if it only render those less fairly abreast of present opinion more alive to the welfare of the communities committed to their charge.

The Section continued the following day to entertain various important subjects, amongst which a paper upon the Influence of Milk in the Causation of Disease, was introduced by Dr. Louis Parkes; and one upon the Sphere of Work of Sanitary Associations, by the Rev. J. M. Lambert. These subjects proved of special interest to the ladies.

Year by year the papers in this Section become more numerous and more valuable; and I would again suggest that the Section be subdivided, or that another Section be added to embrace Sanitary Legislation and Administration and kindred subjects. I trust the Council of the Sanitary Institute will take this into serious consideration.

The Section terminated its labours with success, in harmony, and it is to be hoped with profit.

JOHN F. J. SYKES,
Honorary Secretary.

Section II.—ENGINEERING AND ARCHITECTURE.

This Section met at the Museum, and was opened by the President of the Congress, who briefly introduced the President of the Section, Mr. Baldwin Latham.

Mr. Latham read his remarkable address, on "The Influence of Ground-water on Health," showing an unusual amount of original research, and personal labour and expense in the preparation and record of these researches.

The Dean of York proposed the vote of thanks, which was seconded by Mr. Rogers Field, and carried with acclamation.

It was announced that Professor Robinson could not attend through pressure of business, and his paper on "River Pollution" was read by the Senior Secretary of the Section.

Mr. Vickers Edwards' paper was postponed till the next day, at his request; and the discussion took place on Prof. Robinson's paper.

Surgeon-Major Black, Professor Hope, Mr. Rogers Field, Mr. Henry Law, Colonel Jones, Major Flower, Mr. Tarbotton, and Mr. George Darling (of Leeds), took part in a lively discussion, which turned chiefly upon the relative merits of the solid and liquid disposal of sewage.

The President, in summing up, pointed out some of the advantages of Sewage Farms over which his experience had been exercised.

The Meeting then adjourned for lunch.

On resuming the sitting, papers were read by Alderman Rowntree and Mr. T. H. Harrisson, on Municipal Work, which led to a lively discussion, in which Mr. H. H. Collins, Mr. Lyon, The Lord Mayor, Mr. North, Mr. Rogers Field, Dr. Ewart, Mr. Whitaker, Mr. Tarbotton, Major Flower, Mr. Symons, Mr. Maguire, and Mr. Hanson took part. Mr. Rowntree and Mr. Harrisson answered.

The Meeting closed with the reading of Mr. Tattersall's paper.

Friday, September 24th, 1886.—This Section was continued in the Library, after the opening Address of the President of Section II.

Mr. Gass then read his paper, and Mr. Edwards followed: the discussion of which—and Mr. Tattersall's—was opened by the Senior Secretary of the Section, and continued by Messrs. Tarbotton, Rogers Field, Harrisson, Darley, Gass, Denham, and Emptage.

Mr. Rogers Field announced the speedy publication of the work of the Cowls Committee.

The authors of the papers having replied, the President summed up; and the general feeling was that the business of this Section was well and usefully done, and would prove of good service to the cause. Thanks were voted to the authors of the papers.

EDWARD C. ROBINS.
Honorary Secretary.

Section III.—CHEMISTRY, METEOROLOGY AND GEOLOGY.

The President of the Congress (Sir Spencer Wells) attended at the Museum and introduced Mr. W. Whitaker, F.G.S., President of the Section, who delivered a very lively and extremely interesting Address, dealing chiefly with the water question from a geological aspect, as he very neatly expressed it: "Two of the chief problems in matters sanitary are to get good water, and to get rid of bad water." And he brought the matter home in a most practical way by giving the details of half a dozen gross cases of errors in sanitary matters. He concluded with a protest against the notion which some persons desire to foster, that those who study science in a purely abstract spirit are superior to those who apply their scientific knowledge to the needs of social life. The Address was listened to

with great attention and approval throughout, and a voto of thanks, moved by Alderman Rowntree and seconded by Mr. S. W. North, was carried unanimously.

The first paper, by Lord Brabazon, on the desirability of caring for the body as well as for the mind, and entitled "Open Spaces and Physical Education," was, in his Lordship's absence, read by his Private Secretary. The discussion (but that is hardly the correct term where unanimity prevailed) proved the wide-spread approbation which Lord Brabazon's efforts in this direction have obtained.

Mr. Charles Roberts followed with a paper entitled "On Medical Climatology: a scheme for defining Local Climates by combined Meteorological and Phenological observation." This object is also self-evidently a desirable one, and was supported by every speaker except Surgeon-Major Black, who pointed out that inasmuch as finely grown men were to be found in many manufacturing towns where no tree could grow, there could hardly be a close connection between plant life and human health.

Dr. Percy Frankland's paper on "The Filtration of Water for Town Supply," gave an abstract of his recent observations on London waters by the methods first suggested by Koch, and showed how important was the purifying influence of clean fine sand.

The remaining papers had to be read in abstract in consequence of the shortness of time, but will be found printed *in extenso*, viz.: "On the Sanitary Condition of the Country, with special reference to Water Channels," by Dr. R. T. Cooper, and "On the Collection and Storage of Rain and Drinking Water, with a description of a system for carrying out the same," by Surgeon-Major Pringle, M.D.

G. J. SYMONS,
Honorary Secretary.

MEETING OF SUBSCRIBERS TO THE LOCAL FUND,

HELD AT THE GUILDHALL, YORK,

ON THURSDAY, THE 11th OF NOVEMBER, 1886.

W. REED, Esq., F.G.S., IN THE CHAIR.

In opening the proceedings, the Honorary Secretary (Mr. S. W. North) explained that the object for which they were met was to give an account of their stewardship in promoting the success of the Sanitary Congress and Exhibition lately held in York. The Congress was on the whole most satisfactory, and he thought that any person who took part in it could not fail to have been impressed with the fact that the papers read were above the average, and were full of sound and useful knowledge. Besides the Congress, there was an Exhibition in the Fine Art Institution, which he could testify, from his slight acquaintance with the subject, was in every sense a very good Exhibition. The sanitary Exhibits were excellent, and received most careful inspection from the public. The number of persons who attended was not so large as that in some more populous towns, but was larger than was at first anticipated. The Institute had kindly lent the use of the Exhibition for the purpose of holding a *fête* for the benefit of the two leading Medical charities in the city—the York County Hospital and the Dispensary. The *fête* was a very great success, the total receipts being £106 16s., which was to be divided between the two institutions. The whole of the proceedings, both of the Congress and Exhibition, were highly satisfactory, reflecting credit upon the city and those who had taken an active part in them. He could not close these remarks without expressing the great satisfaction it must be to every citizen of York that the city possesses so large and commodious a building as the

Fine Art Institution, without which it would have been quite impossible to have held such a gathering in York. No local fund could have been raised to erect a building large enough to hold all the sanitary exhibits, and it behoved the citizens to keep it in a proper state of efficiency, in order to fulfil the many useful functions, which were more and more required for the discussion of common objects of interest, such as the late Exhibition. The whole of the local expenses of the Congress, &c., had to be borne by the Local Committee, and when the subscription list was opened it was very fairly responded to, but not so liberally as he at first anticipated. It was estimated that between £600 and £700 would be needed, but only £506 was subscribed. Great prudence and economy had thus to be exercised in every department, but notwithstanding this the subscribed fund was not sufficient. Thanks, however, to a sum which was placed at their disposal by the trustees of the Social Science Congress held in York in 1864, they were able to present a clear balance sheet. Out of the same fund it had also been decided to pay the expenses of the Hospital and Dispensary *fête*. He had received a letter from the Secretary of the Sanitary Institute expressing the Council's appreciation of the very complete and satisfactory arrangements made by the Local Committee, and it was no doubt due in a large measure to those arrangements that the Congress proved so successful.

The following resolutions were then adopted:—

"That the Treasurer's statement of accounts now read be received and adopted, and that he be authorised to pay the same. That Mr. Alderman Brown, Mr. C. M. Luden, and Mr. Alderman Rowntree be requested to audit the same, and that after audit a copy of the proceedings at this Meeting be forwarded to each subscriber to the local fund."

"That the best thanks of this Meeting be presented to the Right Hon. the Lord Mayor of York (Mr. Ald. Terry) for the courteous manner in which his Lordship discharged the duties of Chairman of this Committee, and for the hospitality shown by his Lordship and the Lady Mayoress to the Members of the Institute during its recent Congress in York."

"That the best thanks of this Meeting be presented to the Rev. Canon Fleming, B.D., for his kindness in presiding at the Artizans' Meeting, and for the valuable services rendered by him at the Conversazione."

"That the best thanks of this Meeting be presented to Dr. Naylor for the valuable services rendered by him on the occasion of the Conversazione being held during the recent Meeting of the Sanitary Congress in York."

"That the best thanks of this Meeting be presented to Mr. Skerry for his kindness and trouble in organising and carrying out the details of the Artizans' Meeting in the Festival Concert Room in so satisfactory a manner."

"That the best thanks of this Meeting be presented to the Rev. Canon Raine for his kindness in organising and carrying out an Antiquarian Ramble through the City."

"That the thanks of this Meeting be presented to the Committee of the Wilberforce School for the Blind, and Mr. Buckle, Superintendent, for their liberality in allowing the School to be open to the Members of the Institute during the recent Congress, and for the valuable services rendered by the Pupils of that Institution at the recent Conversazione, under the direction of Mr. William Barnby."

"That the best thanks of this Meeting be presented to the Rev. E. S. Carter and the Rev. A. S. Commeline for their kindness in acting as Honorary Secretaries to the Conversazione Committee and for their valuable services."

"That the best thanks of this Meeting be presented to Mr. Alderman Close (ex-Lord Mayor of York) for the courteous manner in which he has discharged the duties of Honorary Treasurer."

"That the best thanks of this Meeting be presented to the Council of the Sanitary Institute of Great Britain, for its liberality in placing at the disposal of the Local Committee the Exhibition and Staff free of cost, for one evening, in aid of the Funds for the Fête organised on behalf of the York County Hospital and York Dispensary, and to Mr. Box, the Curator, for his courteous assistance in connection therewith."

"That the best thanks of this Meeting be presented to the Chairman and Directors of the York New Waterworks Company for their hospitality to, and for the admirable arrangements made for, the Members of the Institute to inspect the works of the Company at Acomb Landing."

"That the best thanks of the Meeting be presented to the Directors of the York United Gas Light Company for their kindness in allowing the Members of the Sanitary Congress to visit their works."

"That the best thanks of the Meeting be presented to the House Committee of the York County Hospital for their kindness in allowing the Members of the Sanitary Congress to visit the Hospital."

"That the best thanks of the Meeting be presented to the Directors

of the North Eastern Railway Company for their kindness in allowing the Members of the Sanitary Congress to visit their works."

"That the cordial thanks of this Meeting be presented to the Very Rev. the Dean and Chapter of the Cathedral for their kindness in allowing the Members of the Sanitary Institute to visit the Cathedral and Crypt."

"That the thanks of this Meeting be presented to the Council of the Yorkshire Philosophical Society for their liberality in placing at the disposal of the Executive Committee the Theatre and Library of the Museum for the use of the various Sections, and for granting Members of the Institute free admission to the Museum and Grounds of the Society.

"That the thanks of this Meeting be presented to the President, Secretary, and Members of the York Subscription Library for their kindness in allowing the Library to be open for the use of the Members of the Institute during the recent Congress in York."

"That the thanks of this Meeting be presented to the Committee of Management of the York Institute of Popular Science and Literature for their kindness in allowing the Institute to be open for the use of the Members of the Sanitary Congress during the recent Meeting in York."

"That the best thanks of this Meeting be presented to R. W. Boyce, Esq., Governor of York Castle, for his courtesy and kindness in allowing the Members of the Sanitary Institute, attending the Congress at York, the privilege of visiting the Prison and the Ruins of Clifford's Tower."

"That the thanks of this Meeting be presented to the Lord Mayor and Corporation of the City of York for their kindness in permitting the Members of the Sanitary Congress to visit the Fever Hospital, for their liberality in placing the use of the Council Chamber at the disposal of this Committee, and for their co-operation in promoting the success of the Congress and Health Exhibition."

"That the thanks of this Meeting be presented to the Local Hon. Secretaries of Section I.: Sanitary Science and Preventive Medicine, viz., Henry E. Spencer, L.R.C.P.; Francis H. Weeks, F.R.C.S. Section II.: Engineering and Architecture: M. J. Adams, G. J. Monson, A.M.INST.C.E. Section III.: Chemistry, Meteorology, and Geology: T. Gough, B.SC., F.C.S.; H. M. Platnauer, A.R.S., F.G.S.; and to the Hon. Secretaries to Local Sub-Committees, S. H. Adams and Mr. Councillor Procter."

"That the best thanks of this Meeting be presented to Mr. Buckle

(Master of the Yorkshire School for the Blind), Mr. Platnauer (Curator of the Yorkshire Philosophical Society), Mr. Robinson (Master of the Blue Coat School), and H. E. Spencer, Esq., for their valuable services at the recent Conversazione and Hospital and Dispensary Fête, and to Mr. Holmes for the gratuitous loan and management of the Oxy-Hydrogen Light on the last occasion."

"That the best thanks of this Meeting be presented to the Committee of the York Industrial Schools for permitting the Members of the Sanitary Congress to visit the Boys' School at Marygate, and the Girls' School, Lowther Street."

"That the best thanks of this Meeting be presented to the York and Leeds Press for their valuable Reports of the Meetings of Congress and of the Health Exhibition."

"That the cordial thanks of this Meeting be presented to the Subscribers to the Local Fund."

Proposed by Mr. Luden, seconded by Mr. Skerry, and carried by acclamation, "that the thanks of the Citizens are due to the Subscribers to the Local Fund, for having promoted so interesting and successful a Congress and Exhibition."

Mr. Luden proposed a vote of thanks to S. W. North for his valuable services, which was carried by acclamation.

Mr. North, in reply, referred to the valuable aid he had received from Mr. Wilson, the Assistant Secretary.

W. REED, *Chairman.*

A vote of thanks to the Chairman was also carried by acclamation.

S. W. NORTH, *Hon. Sec.*