cases, and was of opinion that the householder should be compelled to notify in conjunction with the medical man. He also drew attention to the ignorance of laymen as to the nature of scarlatina, and pointed out that it was the same as scarlet fever. As to disinfection, he mentioned that in Scarborough one of the best known forms of disinfectors is used, and all infected articles are disinfected *free of cost*.

The CHAIRMAN, Prof. F. DE CHAUMONT, mentioned that with regard to the notification of disease, the practice on the Continent, especially in Holland, was to make it compulsory from both householder and medical man.

Dr. MALCOMSON (Middlesboro'-on-Tees) stated that at that town all the ratepayers and their families and servants were admitted free to the fever hospital, and that the Guardians of the poor paid 35s. per week to the Corporation for pauper patients. The fact that a person had had the Union medical man was taken as a proof that the person was a pauper, and the amount was paid cheerfully, because it was felt to be cheaper to carry this out than for the Guardians to have a hospital.



# SECTION II.

# ENGINEERING AND ARCHITECTURE.

## ADDRESS

BY BALDWIN LATHAM,

M.INST.C.E., F.G.S., F.S.S., F.R.MET.SOC., &c.

PRESIDENT OF THE SECTION.

IN presiding over this section, which is devoted to engineering and architectural subjects, it is necessary that I should say that I have been requested to address you upon a subject which properly belongs to the Climatological Section, namely, upon the probable influence of ground water on health. This request has no doubt been made in consequence of some observations which have been made in this city by Mr. North, the Medical Officer of Health, who has traced some connection between an outbreak of typhoid fever which occurred here in 1884 and the movements of the subsoil water at that time.

Having devoted much time, during the past eleven years, specially to the study of the question of underground water, and having established and maintained a number of stations for observing the relative height of subsoil water in various parts of the country, and having also collected the past records which are available in this country and elsewhere, I am in possession of facts not easily obtainable, and am able, therefore, to draw some definite conclusions as to the probable influence of ground water upon health.

Turning to what may be called historical records, periods of great drought clearly indicate a low state of the ground water, and in ancient records there are some remarkable references to the influence of drought in producing disease.

In the Volume of Sacred Writ, Zechariah, Chap. 14, v. 17 and 18, the effect of the absence of rain in producing plague is clearly set forth, and in a passage in Revelations, Chap. 11, v. 6, men-

tion is made of the with-holding of rain and the production of plague.

Aristotle placed Zoroaster at 6,000 years before Plato, and the latter lived about 360 years before Christ. In the Avesta we have clearly laid down the fact that the absence of rain produces disease.

In these sacred writings it will be observed that the pollution of the earth, water, or air, from any cause, is looked upon as a deadly sin.

The influence of light in destroying noxious properties arising from decomposing matter is also clearly indicated, and it is pointed out that the effect of keeping back the waters of the sky and not suffering them to be poured down on the earth, would be that the noxious animals which live in the water would pollute it.

Again, it is pointed out that the star Tistrya raises the vapours out of the sea and draws the clouds forward, causing the rain to fall. This star was looked up to as the distributor of water, and it is recorded that when the star went to the sea a burning demon came out and scared Tistrya from it. Then the deity of heaven gave strength to Tistrya, and he returned to the sea, and the burning demon came out against him, but was defeated and driven away. Tistrya then raises the vapours of the sea and draws the clouds forward, causing the rain to fall, and so drives away sickness.

No inquiry into the question of the influence of climate on disease would be complete without reference to the labours of Hippocrates. It is curious to note in his works, written upwards of 2,000 years ago, that there are conditions recorded, attending healthy and unhealthy seasons, which are identical with the conditions which may be observed in this country at the present day. Hippocrates taught that all disease may be traced to natural causes, and he counted it impiety to maintain that any one more than another is an infliction of the Deity; and he pointed out to his followers that if they wished to study medicine properly, they must in the first place study the seasons of the year, and the effects which they produce. He also stated that acute diseases occur in periods of drought, and that you could tell what epidemic diseases would attack a city either in summer or winter, and what sickness each individual would be in danger of experiencing. He went much further than our knowledge at the present time enables us to go, for he stated that the changes of the seasons may be predicted from the rising and setting of the stars, so that we could know beforehand what sort of a year would ensue. Hippocrates also pointed out the conditions affecting the health of any period: with rain



in autumn, a mild winter, neither very tepid nor unseasonably cold, and rain in spring and summer, the year is likely to prove healthy; but if the winter is dry, and the spring showery, the summer will necessarily be of a febrile character. If, at the rising of the Dog-star, rains and wintry storms supervene, there is reason to hope that disease will cease, and the autumn will be healthy.

It is curious that a dry winter is often the precursor of disease, not at that time, but in the following autumn. As a rule a short supply of rain in December has a most marked influence upon the stores of underground water, and a deficiency of rain in this month has probably a greater effect in influencing the future health of any particular district than it has in any other month of the year. As a type of a healthy season the present year is an example, and fully complies with the conditions laid down by Hippocrates.

In classic times pestilence was ascribed to the anger of the Sun-God Apollo, or to his twin-sister Diana, the moon, and certainly with very good reason.

> "Along Olympus' heights he passed, his heart
> Burning with wrath; behind his shoulders hung
> His bow and ample quiver; at his back
> Rattled the fateful arrows as he moved.
> Like the night cloud he passed; and from afar
> He bent against the ships, and sped the bolt;
> And fierce and deadly twanged the silver bow.
> First on the mules and dogs, on man the last
> Was poured the arrowy storm; and through the camp
> Constant and numerous blazed the funeral fires."—*Homer.*

It may be interesting to note that some years ago Dr. Laycock published an interesting account showing the incidence of disease in York, from which it appeared that this city was always susceptible to violent outbreaks of disease, traceable to local sanitary circumstances combined with peculiar climatological conditions, and that there appeared the same incidence in the prevalence of the sweating sickness of 1550–51, the plague of 1604, and the cholera of 1832, to which may be added the typhoid fever of 1884.

The results of my prolonged investigations on the subject of ground water in this country and elsewhere, clearly show that there is generally a direct parallelism between the conditions of health and the volume of ground water. The years in which there has been a large quantity of ground water present have invariably been the healthiest years, while those in which there

has been a small quantity have as invariably been the most unhealthy periods.

As a rule the lowness of the ground water indicates the future health, and not the state of health at the particular time of lowness, that is, the unhealthy period, as a rule, follows the period of low water—the degree of lowness indicating the intensity of future disease, especially fever. Sometimes an unhealthy period runs concurrently with the period of low water, but in all these cases there is clear evidence that percolation has recommenced before the unhealthy period takes place. These results are entirely confirmed by observations which were carried on in Paris between the years 1868 and 1883, and which have been collated and published by M. Durand Claye, Chief Engineer of the Municipality of Paris, with the object of putting all the facts and circumstances in connection with the outbreaks of fever in Paris at the disposal of those who might choose to investigate the subject—a course strongly contrasting with the conduct of some authorities in this country, who desire rather to hide the true facts from public view.

The observations which have been published by Professor Pettenkofer, and which were commenced in 1854, differ from the experience gained in this country, as he has shown that typhoid fever in Munich commenced with the fall of the subsoil water, and reached its greatest intensity with the greatest degree of lowness, and with the rise of the water there was a diminution of fever, a result exactly contrary to experience in this country. Professor Pettenkofer's observations, however, agree with the observations made here in the fact that the greatest intensity of typhoid fever coincides with the periods of the greatest degree of low ground water, that is those years in which the subsoil water has fallen to its lowest level are those in which there has been the most fever.

With regard also to the experience in this country as to subsoil water, it may be pointed out that there is clear evidence that the lowering of the subsoil water by artificial means will produce, and does produce, a tendency to the development and dissemination of typhoid fever. The effect of drainage works, during their construction, in lowering the subsoil water where precautions have not been taken to speedily and permanently get the water back to its proper level, has been, in many instances, to cause outbreaks of typhoid fever, which at the time have been attributed to the sewerage works and to sewer gas, even in cases where no connections had, at the time of the outbreak, been made with the sewers.

It may also be pointed out that at the time of the outbreak of cholera in East London, in 1866, as to the cause of which



there has been so much dispute, the very district which was most afflicted with cholera, had, at the time, its subsoil water unduly lowered by the construction of the main drainage works in that part of the Metropolis, but on the completion of this work, when the sewers were brought into operation, the epidemic ceased.

In regard to outbreaks of cholera in this country, I have not been able to find any record showing the actual state of the subsoil water in 1832, the time of the first outbreak of cholera; but in 1831, there was clearly a deficiency of rainfall, which points to the fact that in the following year the subsoil water would probably be low. In 1847, the year preceding the cholera outbreak of 1848–9, the subsoil water over a large area was undoubtedly low. In the cholera outbreak of 1854, we had a very low period of subsoil water over a large part of the country, and in 1865, immediately preceding the outbreak of cholera in 1866, a similar state of things occurred. With reference to cholera, it should be noted that the conditions of underground water which affect the outbreak, should be observed in those countries where the disease first makes its appearance.

It is curious that in recent times as a rule there has been, every ten years, a marked period of low water; for example, in 1834–5, 1844–5, 1854–5, 1864–5, 1874–5, 1884–5. The lowest water in this series probably occurred in 1864–5. In 1844–5 the low water was not intensely low, but it was low compared with the period. In addition to these periods, there are other times of low water, and in investigating the subject it should be studied locally and comparison made with local vital statistics, for the largely varying distribution of rain tends to equalise results when spread over large areas, as the same conditions rarely occur over extended areas at the same time.

I have carried on, as many of you know, very extensive observations at Croydon on ground water, and in consequence of the results there obtained I have extended them into various geological formations in different parts of the country. I propose now, however, to deal with some of the Croydon results, not that Croydon possesses any exceptional circumstances either with regard to health or disease, but that my intimate knowledge of the district enables me to study all the attendant conditions, and, moreover, in Croydon and its neighbourhood we possess a long record of the condition of the ground water.

The register of Croydon goes back to the year 1539, and with the exception of years in which there has been revolution, or disturbing causes of a kindred character, the record is complete. A tabulation of the whole of the burials and baptisms, extending from this early period to a date overlapping that

when registration of births and deaths commenced, clearly indicates that years of drought are, without exception, the most unhealthy periods.

We possess too, in this country, rainfall records extending back over a period of 200 years, and we have a large amount of concurrent history telling of the state of the weather from very early periods. For example, in 1539, the first year of registration at Croydon, there is a record that in this particular year the springs were remarkably low, so low that the River Lea was nearly dried up, and writers of that age remark on the great drought and heat of that period. In that year the number of burials recorded in Croydon was 50, and the number of baptisms 55, indicating a probable death-rate of 25·6 per thousand. In the following year on the rise of the water, the burials rose to 87, and the baptisms 72, indicating that the death-rate was nearly 32 per thousand. Coming to the period when we have rainfall records, the year 1741 was a very dry time, the rainfall at Lyndon for the year being 15·7 inches, and in that year the burials in Croydon were 271, and the baptisms 113, giving a probable death-rate of 63·7 per thousand, while in the two years preceding this year, the death-rate was 27·7 and 40·7 per thousand, and in the following year 24·2 per thousand. As we arrive at more recent periods when we have the certain records collected by the Registrar-General, registration having commenced in the dry year of 1837, the death-rate at Croydon was 30 in the thousand; in that year and in the following year a similar rate occurred. In the years of very low water 1854 and 1855, we had death-rates of 26·84 and 21·14 respectively, while in 1851, the death-rate was only 18·72 per thousand. In the dry periods 1864 and 1865, we had death-rates of 21·5 and 22·7 per thousand, while in 1860, a wet year and one of high springs, the death-rate was only 17·27 per thousand. The year 1871 was another dry period, but the low water at Croydon was not so intense in this year as in other years. The death-rate was not so high, viz., 18·89 per thousand, but in 1873 when the springs were very high, the death-rate fell to 16·59 per thousand. After the dry period of 1874–5, the death-rate rose again to 21·10 per thousand. From 1876 up to the beginning of 1884, there was unprecedented high water, and during the whole of this period the country generally enjoyed a high state of public health. The conditions, however, which have secured for us the estimable boon of good health, by removing the cause of much sickness, suffering, and death, have been disastrous to the agriculturist, as the large quantity of water passing into the ground has washed away the fertilising elements.

By reference to the returns of the Registrar-General, which



show the deaths in every quarter of the year, it will be seen that, with the single exception of the September quarter of 1849, the period of the cholera epidemic, the most unhealthy periods are invariably those quarters immediately following the periods of low water; as for example, the March quarters of 1838, 1845, 1847, 1853, 1855, 1864, 1865, 1866, 1875, and the increase of deaths in these quarters is so large as to clearly indicate a direct connection between the sanitary influence which the state of underground water denotes, and that of public health. With regard to deaths from fever, in recent times the years in which there has been the lowest subsoil water generally in the country are shown to be the most unhealthy, as for instance the two years 1864, 1865.

The year 1884 was an exceptional year in Croydon, and it is by means of such exceptional periods that we are able to draw some conclusions as to the probable influence of ground water upon health. It is clear to my mind, after the most careful consideration of this subject, that ground water itself has no influence, either for good or evil, upon health, but that the lowness or the highness of the water in the ground is the index of conditions which greatly influence the health of all communities. We have periods of abundance of water, and periods of low water with both healthy and unhealthy conditions. Ground water has been shown by Professor Pettenkofer to be chemically more impure in periods of high water when the conditions were favourable to health than when there is a low state of the ground water, and the conditions are unfavourable to health. The records also show that we have had periods when rain has brought malignant diseases into existence, while, on the other hand, we have similar heavy rainfalls accompanied by a high state of public health, as in the present year.

The records clearly point out that it is not one circumstance alone which produces disease, but that there are at least three factors necessary for the production and distribution of disease, especially typhoid fever, viz.:—

1. The elements which produce disease, such as a polluted state of the ground.
2. The conditions which are necessary for the development of disease, such as a period of dryness of the ground in those regions which are usually occupied by water, combined with a comparatively high degree of temperature.
3. Conditions which will lead to the spread of the disease such as the probable influence of a storm or rain in driving impurities out of the ground into our water

supplies, or through the instrumentality of ground air passing into our habitations, and its reception by a population which is in a condition to receive such germs of disease.

If any one of these conditions is absent, diseases like typhoid do not occur.

The long period of washing and purification which the ground has passed through since 1876, has generally so purified it from the producing elements of typhoid fever that, with the exception of occasional cases of impurity where the ground has become fouled from the leakage of sewage from the imperfect sewers and other direct sources of pollution, as in the case of this city, Beverley, Kidderminster, and some other places which suffered from epidemics in the low water period of 1884, the country has enjoyed comparative immunity from diseases of this class. On the other hand, if we take a period when there has been marked low water for a number of years, followed by unusually low water at particular periods, these are the times when typhoid fever is most rife, as for example between 1854 and 1865, excepting only the years 1860 and 1861, when we had a high state of ground water. The intensity of the fever rates of 1865 and 1866 point out a lesson which ought to be learnt by every sanitarian—that we must keep the ground free from impurity, if we wish to secure conditions which are essential for the promotion of health.

When we come to deal with local conditions preceding disease, we find that not only cholera and typhoid fever, as pointed out by Prof. Pettenkofer, are amenable to the conditions indicated by the highness or lowness of the ground water, but probably all other zymotic diseases, with the exception of diarrhœa, are influenced by the conditions which produce low ground water. At the Leamington Congress of this Institute in 1877, in a paper which I read on this subject, I quoted and reproduced a table from the work of Dr. Macpherson, showing that the incidence of small-pox and cholera was identical at Calcutta, and that both these diseases became virulent at the period of lowest ground water. Small-pox in this country appears to occur when the ground is drying, and is most prevalent in the years of lowest ground water. The conditions affecting measles are almost identical with those of small-pox. Scarlet fever and diphtheria follow almost on the lines of typhoid. They are the least prevalent in the years of highest ground water, and rise and fall with the increase and diminution of percolation. Whooping cough is ordinarily most prevalent at those periods of the year when the ground water is at its highest position, but is also prevalent in years of low ground water. The period of



percolation is that when most of the zymotic diseases run their usual course, that is, they commence with percolation and gradually decline as it ceases. Fifty years of percolation observations at Nash Mills carried on by Messrs. Dickenson, and more recently by Dr. John Evans, F.R.S., when put into tabular form, show percolation to be almost co-incident with zymotic diseases.

We must not, however, lose sight of other conditions which are at work, such as—

(1.) *The influence of light.* It will be observed with reference to the period of percolation that it is almost parallel with the time the sun is below the horizon. The influence of solar light is well-known in malarious countries, which may be traversed with impunity while the sun is above the horizon, but not after night-fall.

(2.) *The influence of temperature.* There is no doubt that, in winter time, many diseases are aggravated by the intensity of cold, but cold is not a general cause of disease, especially in children under five years of age. This was shown by the late Dr. Farr, and in the volume recently published by the Sanitary Institute, it is pointed out that the death-rate of children in Norway is lower than that of England, while the death-rate of children in England is lower than in Italy, indicating that at this period of existence cold is not detrimental to life. When we come to isolate the deaths in particular months, and compare them with the periods of low water, it often happens that extreme low water in winter corresponds with periods of great cold, and low water in summer also corresponds with periods of great heat. It is only at such times when we are able to discount these influences by comparing them with periods when we have a normal state of things with reference to temperature, and abnormal in regard to ground water, that the influences measured by the ground water are brought into prominent relief.

In the records which have been published by M. A. Durand-Claye, for Paris, data are supplied which give information upon a variety of conditions likely, or unlikely, to affect or influence the development of typhoid fever, such, for example, as barometric pressure, wind direction and force, temperature, rainfall, observations with the actinometer, hygrometer, evaporation, geological character of soil, physical character of soil, height of ground water, density of population, distribution of water of various kinds, distribution of baths, lavatories, wash-houses, distribution of furnished apartments, length of sewers both in district and constructed during the period of epidemic in 1882.

Prof. Pettenkofer, in his researches, has not ignored the conditions which affect epidemic disease, for example the conditions

of wealth as contrasted with poverty. He clearly shows that poverty has a marked influence in the dissemination of disease, and that epidemics fall more lightly upon the wealthy classes than upon those who are not so happily circumstanced. However, occasionally typhoid fever attacks the wealthy classes more violently than those less favourably circumstanced, as was the case in Croydon in 1875. In this instance the best districts were in the position of receiving the poison in great intensity.

The records of Paris show that typhoid fever is lowest in June and highest in December and January. The increase generally takes place in August, or the period when percolation first commences. An exactly similar state of things is shown to be the case in Croydon. When the number of deaths is small the curve is not clearly indicated, but the lowest number of deaths occurs in June and the highest in January. The following figures show the proportion in the respective months in the period of registration at Croydon from 1837 to 1886, and in Paris 1865–69 and 1872–81.

| Month. | Croydon. | Paris. |
|---|---|---|
| January ... ... ... | 152 ... | 1,478 |
| February ... ... ... | 97 ... | 1,585 |
| March ... ... ... | 100 ... | 1,496 |
| April ... ... ... | 118 ... | 1,278 |
| May ... ... ... | 99 ... | 1,080 |
| June ... ... ... | 73 ... | 933 |
| July ... ... ... | 87 ... | 1,200 |
| August ... ... ... | 89 ... | 1,904 |
| September ... ... ... | 106 ... | 1,884 |
| October ... ... ... | 116 ... | 2,014 |
| November ... ... ... | 130 ... | 1,975 |
| December ... ... ... | 110 ... | 1,641 |
| Totals | 1,277 | 18,468 |

The different length of each month must be taken into account, and in the case of Croydon, where the numbers are small, the influence of epidemic periods interferes with regular order; but when these separate interferences which tend to swell the numbers in particular months—as, for instance, in April—are studied, they become clear indices, and point more directly to the conditions attending this particular disorder.

A very marked circumstance in connection with ground water, and the period of percolation, is shown in the case of deaths of children under five years of age. While there may have been mistakes with reference to the causes from which a child dies, very little error occurs with regard to its age. I am of opinion,



that the proper way of estimating the sanitary state of any period in any district, is by taking the number of children under five years of age, and calculating the deaths by the number living at these ages. The figures show, especially after deducting the deaths from diarrhœa, which are influenced by high temperature, that there is an almost exact parallelism between the period of percolation, and that of deaths occurring at those ages, the smallest number of children dying in the month of June, and the largest number in December and January. Moreover, the death-rate from year to year, fluctuates in a very marked manner with the fluctuations of the ground water. The most healthy periods are those in which there is the most ground water, and the least healthy are those in which there is the least ground water in any year. These results corroborate the strong relation which apparently exists between the state of water in the ground and zymotic diseases. It also shows that there are influences at work, which can be measured by the quantity of water in the ground, and which are destructive to young life, but which may be guarded against, as these influences indicate themselves many months before they begin to affect the population, therefore "to be forewarned is to be forearmed."

The fluctuation of the water line therefore is an essential condition in the development of disease, especially typhoid fever and cholera. It has been pointed out by Professor Pettenkofer that in those districts in which the rivers are held up at uniform levels by weirs, the conditions are favourable to health, and in such districts cholera rarely becomes epidemic. In a great measure this is corroborated in this country by the state of health at our sea-side resorts, which being the natural outflow for ground water, and owing to the uniform height of mean tide level, are without exception placed in a condition favourable to health. We have also the record in connection with the City of York, in which it is clearly shown by Dr. Laycock, in his report on York, published in the first volume of the Health of Towns Commission, that previous to the construction of the lock at Naburn below the city, the tide used to flow up above York, and there were considerable variations in the level of the waters from time to time, but after the construction of the lock in question the health of York materially improved. The health of districts, such as the Wandle Valley, is proverbial. In the latter district there are a large number of mills in a comparatively short length holding up the water to a uniform level.

With such examples for our guidance, it is clear that sewers may be of great advantage in maintaining uniformity in the water level. On the other hand, leaky sewers are liable not only to pollute the ground, but to cause considerably greater varia-

tion in the levels of underground water than would otherwise occur in various parts of the district. Good land drainage has a tendency to produce uniformity of water level, but such uniformity should rarely be attempted to be secured through the instrumentality of sewers carrying polluted matters. The influences which are observed clearly point out how important it is to guard districts against pollution of the earth. How little regard, however, has been paid to this point, for it is only within the last ten years that the importance of making sewers as water-tight as possible has received serious consideration, and still, in many parts of the country, sewers are being constructed without any regard to water-tightness and their other influences on ground water. Moreover, a large number of burial grounds have been established, in quite recent periods, in positions with respect to underground water which must more or less exercise a baneful influence on the health of the localities in which they are situated. Cess-pools, ash-pits and middensteads are still permitted to poison the air, ground, and water. No wonder that the towns which possess the means of most readily polluting the ground have, without exception, the highest rates of mortality. There can be no compromise in sanitary matters. It should be the aim of all sanitarians to preserve the ground from all impurities, especially in districts where the soil is of a porous character, and, above all, no supplies of water for dietetic purposes should be taken from wells sunk in the immediate subsoil in populous places; and finally, to secure the full measure of health, our houses should be so constructed as to prevent the admission of ground air into them.

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The President of the Congress, Sir T. Spencer Wells, Bart., said, from the way in which the address of the President of the Section had been received, it was almost unnecessary to move a vote of thanks to him, but as the address could not be debated, he would ask the Dean of York to speak.

The Dean of York, rising in obedience to the call which had been made upon him, said he really did not know how to express his sense of the vastness of the subject, nor of the marvellous care, intelligence, and perseverence with which it had been dealt with by Mr. Baldwin Latham, and he offered his own tribute of appreciation of the extraordinary labour displayed in this address. This question of water supply had been one which had received the greatest attention of all peoples from the earliest times. The speaker had referred to the writing in the Scripture of the time of Zechariah; but



the subject was one of interest to Abraham, and there were many interesting passages concerning the matter which the President of the Section had discussed in this paper. What he had heard had impressed him with a sense of responsibility in regard to doing all that was possible to keep our supplies of water pure and unpolluted, and it was to be hoped that all persons who had had facts of such importance laid before them would do all they could to strengthen the hands of all who, like the President of the Section, were endeavouring to keep pure the supplies of water.

Mr. Rogers Field (London), in seconding the vote, said that though he was aware there was some difference of opinion on some of the points raised by Mr. Latham, he coincided generally with the views expressed in the address, and more especially in what had been stated as to the lesson to be drawn by every sanitarian from the facts related, viz., that the ground must be kept clear from pollution if we wished to secure conditions essential to health. The speaker gave particulars of two cases which had come under his notice bearing upon the subjects under review, one being in connection with a large mansion in the Midlands, and the other in relation to a lunatic asylum in the West of England, in which there had been pollution of the water supplies, one from the drainage percolating into the wells, and the other by the drainage from a graveyard.

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## *On "River Pollution," by* Professor Henry Robinson, M.Inst.C.E., F.G.S.

In view of the near approach of legislation on local government, there is every prospect that the long delayed subject of the prevention of the pollution of the rivers of this country will receive the attention which it deserves. In an address on "River Pollution," which was delivered at the "Parkes Museum of Hygiene" in 1885, I called attention to the various Bills which had been brought before Parliament for the purpose of effecting some improvement on the existing unsatisfactory state of affairs. I referred to the Standards of purity which were proposed to be adopted, and which have been the cause of much difference of opinion even amongst those who are striving to accomplish some reform. As this address elicited an expression of opinion from many well known authorities who took part in the discussion upon the occasion,

and as the various Bills were specified, and the Standards given, I have placed on the table a few printed copies of these proceedings for the use of those who may wish to refer to them. Since the date of that address a further Bill for the Purification of Rivers was prepared and brought into the House of Commons by Mr. Hastings, Earl Percy, and Colonel Walrond, acting in conjunction with Mr. Willis-Bund and Mr. Burchell, who have worked arduously and earnestly in the cause. This Bill, besides conferring on the sanitary authorities mandatory powers instead of permissive (as in the case of the Rivers Pollution Prevention Act, 1876), contained also a Schedule of Standards for liquids that may be discharged into streams. It also contained a clause for the removal of complaints from the County Courts to the High Court of Justice. This Bill was, however, withdrawn, the vexed question of the Standards causing, I think, the loss of support from some quarters.

In 1886 a short Bill was brought into the House of Lords by Lord Balfour, to amend the Pollution Prevention Act, 1876. No Schedule of Standards was annexed to this Bill, and this I consider was a very wise departure from some of the previous Bills. This, however, was not proceeded with, owing, I believe, to the disturbed state of business in the last session of Parliament. The simple provisions of this Bill appear to me to remove the grounds of opposition which applied to that of 1885, and it is to be hoped that the promoters of it may have their hands strengthened by the support of this Congress in their efforts to obtain a much needed reform.

The Rivers Pollution Prevention Act of 1876 was "An Act to make *further provision*" for the prevention of the pollution of rivers. The "provision" referred to as then in existence prior to that Act had obviously been wholly inoperative, as the House of Lords in 1876 recorded, in the preamble of a Bill, the fact "*that the pollution of rivers had lately so increased as to become a* NATIONAL EVIL," and it is notorious that the rivers in 1876 were far fouler than they were in 1873. The "*further provision*" has proved equally inefficient. During the 10 years of its existence the pollution of rivers has continued unchecked, and their condition now is much worse than it was in 1876. The main object of further legislation should be to render that "*further provision*" effective, so that the Act of 1876 may be enforced with certainty, and with the least possible friction, real or imaginary, as regards all existing interests. No alteration should be made either in its peremptory prohibitions against the offence, or in the exemptions therefrom embodied in Sections 3, 4, and 5, for the protection of Sewer Authorities, Manufacturers, and Miners using proper means for preventing



river pollution. The restrictive enactments introduced in its 6th Section should be revoked as they have paralyzed the action of the Statute and rendered practically worthless its prohibitions. The removal alone of those restrictions would give vigour to the Act and efficacy to its prohibitions, and by converting the permissive powers into mandatory requirement, the effective operation of the law would be secured. The utmost protection should be afforded to the sewer authority, as well as to the manufacturer and the miner who is doing (as he surely ought to be compelled to do) all that reasonably can be done to prevent or lessen such a fearful public nuisance.

There is no longer any excuse for discharging sewage in an unpurified state, as the conditions which have to be observed in the purification of sewage matter are now well known, and are capable of being easily complied with. The field of conflict which a sanitary authority has now to enter upon in carrying out a scheme of sewage disposal has been so much narrowed by the experience of recent years, that no difficulty has to be encountered which should deter an authority from taking steps to cease to offend in this respect. My experience leads me to think that in sewering large districts it is often undesirable to concentrate the sewage at one point. Very costly works can in many cases be avoided by sub-dividing an extensive area into a few groups for sewerage purposes, according to the physical conditions which exist.

The data and opinions that are given in my book on "Sewage Disposal,"* apply as truly now as they did when it was written.

The chemical treatment of sewage by simple and well known means, enables a fair standard of purification to be attained. Where the highest standard is necessary, it can be effected by the subsequent filtration of the effluent water through a small area of land or through an artificially prepared filtration bed.

The sludge from chemical treatment no longer presents the difficulty which was originally experienced. The mechanical reduction of the sludge from a liquid to a semi-solid condition is now easily carried out in presses. The successful pressing of sewage matter into a form which enables it to be economically removed from the place of production, disposes of one of the difficulties which has to be met in dealing with sewage upon land. The abstraction of the larger and more clogging matters from sewage, by means of screening tanks, before the sewage is passed through land, is

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

now recognized as greatly aiding the soil in its purifying action, and as simplifying the work of irrigation by rendering the dissolved fertilizing ingredients in sewage more capable of being assimilated and utilized. In my own practice, I employ upward screening tanks to retain the larger suspended matters underneath the screening material, by which the matter thus retained is not exposed to the air until its removal either to be pressed or to be otherwise dealt with. The cakes can now be made as thick as two inches, this being now done by Mr. Crimp at the Wimbledon Sewage Works. By mixing about 5 per cent. of fresh ground lime before pressing, cakes of this thickness of two inches are obtained for about 2s. 9d. a ton containing about 50 per cent. of water. The experiments that have recently been made by Dr. Munro, of Downton College, Salisbury, indicate that sewage sludge will find an agricultural use of importance when the system of precipitation is properly conducted. A valuable communication on this subject has been made by him to the Society of Chemical Industry, and further practical researches in the same direction are now being prosecuted, the results of which are awaited with interest. His experiments show that the pressed sludges from either straining tanks, or from the better systems of chemical precipitation, require to be reduced to a finer state of subdivision than is usual (except with the "Native Guano"), to enable the nitrgoen and phosphoric acid in them to be presented to the soil in a form which admits of these valuable ingredients being assimilated and not wasted. These experiments point to sewage sludge, when properly manipulated as indicated, being a useful manure for farmers (as chemical analyses have always suggested), and offering some pecuniary return to the places producing it.

With reference to the purification of sewage upon land the experience that has now been gained prevents those mistakes being made which were fallen into in cases where irrigation was adopted under unsuitable conditions. The important researches of Mr. Warington, at Rothamstead, upon "nitrification," have thrown a flood of light upon the changes which take place when sewage matter is passed through the soil. He has established the fact that the purifying action, which was previously termed oxidisation, is due to the action of minute organisms of the bacteria family. His experiments appear to show that the organisms are generally present down to two feet from the surface, but that below this level their presence is less certain and the nitrifying powers cease, or, at all events, are exerted to a very feeble extent. The important bearing that these investigations have upon the purification of sewage



on land is that they indicate that a much less depth of soil is efficacious than was originally thought to be the case. Consequently the heavy cost of deep draining is unnecessary, and the expense involved in laying out land for sewage disposal purposes is greatly reduced.

As regards the pollution from solid and manufacturing refuse it was proved by the evidence, which was given before a Committee of the House of Lords, that no insuperable difficulty existed in the way of preventing river pollution from this cause. Sir Lyon Playfair stated in evidence before this Committee, as follows:—"If you force us to purify the water which we discharge fouled in this way, before long we shall find efficient modes of doing it. At the present moment we have not efficient modes of doing it, and yet, as one of the largest polluters of waters in the kingdom, from this very thing I advocate that you should make me purify the water before I discharge it."

The removal of the solid matter from manufacturing refuse before discharging it into rivers can be effected by mechanical means in a vast number of cases, where no attempt is now made to do so. The enforcement of such remedial measures need not interfere unfairly with trading interests if the standard of purity which is required is not unreasonable, and is not arbitrarily fixed without regard to the circumstances both of the river to be protected, and of the trader to be dealt with.

I assert with confidence that there is no justification whatever for continuing the employment of our rivers as carriers of the fluid refuse of the community. London, Glasgow, and many other large towns may be cited as abusing their rivers, and are not (as they should be) taking the lead in promptly discontinuing this pollution.

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Mr. Blyth gave his experiences of tests he had made of the Thames water taken at Charing Cross, and said he found it perfectly pure, after it had settled. It was only the abuse of the river that prevented it from being used for domestic and other purposes. The water he had tested never was salt. He should have thought the tide coming up would have brought salt water with it.

Professor Hope (York) spoke on the subject as an analyst, and one who had spent much time in the study of agriculture, both practical

and scientific. He expressed his disagreement with one or two minor points, and then went on to deal with the question of the utilisation of sewage. He feared the value of the sludge as manure would not be as great as could be wished, either by the town on one hand or the farmer on the other, who would be glad to have another good manure at market value, and the town glad of an outlet for their refuse. Lime appeared to be the least desirable item to mix with organic matter intended for manure; any ammonia would be lost, which is the most valuable part, and it would further tend to cause other forms of combined nitrogen to decompose and form ammonia. He suggested that sulphate of lime in the form of gypsum, or of plaster of Paris would probably give an equal result, as far as the mechanical operation of pressing a sludge cake was concerned, and would certainly give better results as a manure. Lime would tend to increase any smell in the process of manufacture, the sulphate would tend to decrease any nuisance that might arise. Sewage systems seemed to resolve themselves into two great divisions: the sewage is taken to the land or the land is taken to the sewage. Lime and clay, the principal precipitants used, were only particular kinds of earth. In the latter case the earth, plus a small quantity of sewage, was taken back to the land as manure; the double carriage was obvious. The former system of sewage farming was the only one which had been worked to a profit. He put aside the precipitating processes as being only worthy of serious consideration when they were the only alternative, that is, in the absence of sufficient land of suitable quality for sewage farming. A sufficient quantity of suitable quality was the great difficulty, and might entail the expense of carrying the sewage some distance from the town before such land could be met with. The question asked by the town was: Upon how little land can we dispose of our sewage? The proper question to put seemed to be: How much land will our sewage fertilise? The quality is equally important with the quantity, and should be of an open sandy character, which naturally drains itself, and in such a locality that there would be no fear of damaging the water supply by percolation into the sub-soil. Such land was generally on a high level, whereas the town seeks to avoid pumping by carrying the sewage to low-lying land often of a clay character and unable to drain itself of its own rainfall, and so low that there is no outfall for artificial drainage. It seems to be thought—if actions speak louder than words—that a dry land plant can become aquatic at a moment's notice provided plenty of food be supplied. This is not only untrue but is the reverse of the truth. To get over the difficulty of draining the farm pumping is resorted to, which means pumping the rainfall of the farm in addition to the rainfall of the town, plus its sewage. How much more convenient to pump the latter to a sufficient elevation, so that it can be taken to and distributed upon land which will drain itself, and which, if farmed by a competent man and not by the town council, who cannot be expected to be versed in farming matters, there would, in times of general agricultural prosperity, be a handsome profit to the credit of the ratepayers; and in times so adverse as the present they might reasonably expect to escape without loss, provided that the farm was not saddled with the cost of legal expenses in gaining compulsory possession of land, &c. It would be foolish to expect any scheme to pay interest on so much sunk capital as many farms are debited with. Precipitation processes had hitherto been a serious expense to the communities adopting them. They had never paid their own way; and until they were able to save the soluble nitrogen in the urine—the most valuable part—they could never hope to do so. Farmers required value for their money, and an increasing number yearly saw that they got it. The only known method of saving the soluble compounds of urine was by the living roots of plants. He had visited many sewage farms, and had made very careful enquiries as to the health of the labourers and their families living upon or adjacent to the farm, and was glad to find good health—improved health—and no trace of zymotic disease. The statement that fresh sewage was harmless appeared to be proven.



The CHAIRMAN asked Professor Hope if he could say what was the agricultural value of the sewage sludge; was it worth the 2s. 9d. a ton it cost to press?

Professor HOPE (York) replied that the value depended entirely upon the constituent part of the sludge, and he could not say unless he analysed it. To buy this material for the land without analysing it was like buying a "pig in a poke."

Mr. ROGERS FIELD, M.Inst.C.E. (London), could not agree with the suggestion in the paper that deep drainage was not necessary, because it had been shown by Mr. Warington's researches upon nitrification that the lower you go down in the soil the less are the powers of minute life to effect nitrification; and he contended that the employment of shallow drains would in many cases lead to trouble. The great objection to shallow drains was that there was a danger of the sewage passing directly to the drains instead of filtering through the soil, and this was especially the case where the soil was of such a nature that it would be liable to crack. He said, therefore, that even if it were proved beyond doubt, which he believed it had not yet been, that nitrification took place altogether on the surface, it would be advisable to drain the land some five or six feet deep, so as to avoid the danger of the sewage passing directly into the drains and being thus carried into the water-courses.

Mr. HENRY LAW, M.Inst.C.E. (London), held that there could be no doubt of the importance of putting drains at the depth of five or six feet. In regard to the so-called investigations of Mr. Blyth into the character of Thames water taken at Charing Cross, these investigations ap-

peared to be of a very primitive character, and that gentleman would find valuable information, more valuable than his own experiments, by consulting the report of the Royal Commission on the discharge of sewage into the Thames. Mr. Blyth would find from this report and the investigations of the Royal Commission, that sea water found its way up the Thames, as was clearly proved by samples of water taken opposite St. Paul's at spring tides. He could also refer to the interesting experiments made at the instance of the Corporation of London and of the Metropolitan Board of Works with floats, showing the manner in which the waters flowed and ebbed within certain limits, and Mr. Blyth would acquire much information from a study of the diagrams which had been deposited at the office of the Local Government Board. As to the use of lime in the process of solidifying sewage, a certain amount of this material was necessary in the pressing. With regard to the view of Professor Hope, that the best treatment of sewage was to take it to the land, with that the speaker agreed; but he thought that in a sanitary point of view it would not be wise to put crude sewage upon the land, inasmuch as the solid matters remained upon the surface long enough to create evils injurious to health.

Colonel Jones (Wrexham) called attention to the differences between *clarification* and *purification* of the effluent from sewage, and maintained that purification could only be obtained by means of land and plant life. Mr. Blyth would find by reference to the report of the Royal Commission, that, so far from considering that the Thames was none the worse from the pouring of sewage into it, it was held that there should not be any solid matter put into the Thames from the Nore upwards, and this was a matter of first importance. As to the scheme of the Metropolitan Board of Works, to clarify the water at Barking and Crossness outfalls by chemical treatment, he held it would be far better to adopt plans to carry the sewage lower down the river, where the solid matter could be deposited on the low-lying land, and the clarified effluent discharged into Sea Reach, "below Hole Haven," as recommended by the Royal Commission.

Major Flower (of the Lee Conservancy, London) held that much difficulty had been caused in river purification by the lawyers insisting upon standard of purity clauses in Acts of Parliament, and he regretted that Mr. Michael had retired from the council of the "National Society to secure effective Legislation against River Pollution" on some such question, which lawyers insisted was necessary. There was, in the question of the purification of rivers, not only pollution by sewage to be considered, but there was the question of manufacturing refuse, which found its way into the sewers. Now if the manufacturers could be made to see that it would be an economical benefit to themselves to utilize their wastes, there would not be the present amount of river pollution; for indeed



it was the manufacturing refuse cast into the river which caused the largest amount of the abominable condition of things. As to the disposal of sewage, he thought it must be treated first chemically, and then passed upon the land; that was to say, it could not be sent directly upon the land in all cases, and he regarded the pressing of the sludge as a capital way of treating it, and as a great advance on former methods. At Leyton, Essex, where the sludge was treated in this way, and the effluent run into the Lee, it was intended, he believed, to incinerate the cakes of sludge and reduce them to powder, and then the sewage matter to be pressed would not require lime, the powder being used instead, so the bulk of the deposit would not be increased.

Mr. M. Ogle Tarbotton (Nottingham) pointed out that the circumstances of different towns varied so greatly that it was impossible to lay down what should be one uniform system of treatment. The sewage in some places was sewage proper and nothing more; but in other places the sewage matter consisted largely of manufacturing refuse, and the sewage was, owing to fluctuating rainfalls in different localities, correspondingly diluted. From the amount of chemicals used in bleaching and dyeing, it could be readily understood that where that process was carried on the cost of purifying the sewage was greater than in other places, and hence the population generally paid for the cost of carrying away the refuse of the manufacturers.

Mr. G. Dodds (Leeds) stated that he had been informed by a manufacturer, in regard to the River Purification proposals, that if he had to give up running his refuse into the river Aire he should have to give up his business. The speaker proceeded to speak of the high estimates which were at first made of the value of deodorised sewage as manure—as much as £6 per ton, and then dealt with the terrible pollutions of the rivers near manufacturing towns. He said that he had spent some time in taking specimens of the polluted condition of the Aire, and if the Royal Commission had seen these specimens, no more evidence would have been required as to the evils wrought by manufacturing pollution.

The Chairman, Mr. Baldwin Latham, in closing the discussion, said that Professor Robinson, if he had been present, would have been quite equal to the task of dealing with the views of those who had discussed his paper. In Professor Robinson's absence he would take upon himself to point out the difference between the question of the utilisation of sewage on land, and that of the pollution of the land. In his own address he laid down three essential conditions as necessary to produce disease, and had declared that in the absence of one condition, disease was not produced. They had the experience that in the years when the ground was saturated with water the period was a healthy one, and he was not going to say that sewage farms

should be established where there was the slightest chance of contaminating underground water supplies. He could not help referring to the fact that in 1875 there was a violent epidemic of typhoid fever at Croydon, and that the sewage of this place was applied directly to land without defecation, and at that time the inhabitants surrounding the sewage farm procured their water supply from local wells, the water in which fluctuated with the proximity of the irrigation works to them; yet in this year there was not a single case of typhoid fever in that neighbourhood. He acknowledged that in some cases, where the three essential conditions for producing disease were present, there disease would come; but what he wished to impress upon the minds of his hearers was, that the placing of sewage direct upon land did not necessarily produce disease, as some seemed to think. With regard to the Bill for the Purification of Rivers, it had been stated by Major Flower that Mr. Michael had withdrawn because a standard of purity was objected to. The fact was, however, that Mr. Michael's withdrawal was due to the Bill being badly drawn. On the point of the manufacturers' pollution of the rivers, there was no desire on the part of anyone to injuriously affect manufacturers; but it would be well for manufacturers to take note of the fact that water was likely to be increasingly dear, and the more it was polluted the dearer it would become. They could not, by reason of their pollutions, use the water which flowed by their premises, and they had to buy water which was brought from a distance. Now it was for them to take into consideration whether it would not ultimately be cheaper for them to purify the water they used than to buy water. He proposed a vote of thanks to Professor Robinson for his paper. This was carried unanimously.

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*On "The Sheffield Corporation Sewage Works," by* JOHN MERRILL, Chairman of the Sewerage and Rivers Committee, Sheffield Town Council.

THE population of Sheffield is a little over 300,000. There are about 19,000 acres within the borough, 5000 of which are sewered and drained. There is no separation of surface from house drainage, and the daily dry-weather flow is ten million gallons.

The disposal of the sewage of the borough had occupied the attention of the Council pretty continuously during the past twenty years, and although several engineers of eminence had



been consulted, no action had been taken, when about four years ago the pressure of an application to the Court of Chancery forced upon the Council a necessity for immediate action.

A Committee was at once appointed with instructions to advise the Council as to a suitable scheme, with a view to its speedy adoption. As the result of an exhaustive consideration of the subject, the Committee laid down a series of conditions which they considered indispensable in a perfect scheme, though not with the expectation of finding any one which complied with the whole of the conditions.

The conditions were:—

1. The process must not only cause no nuisance, but there must be no appreciably disagreeable smell, because in the case of sewage operations it is found that a very little smell soon gets magnified into a very great nuisance.
2. The process must be one that can be carried on at all times and in all seasons.
3. The system must be one which will lend itself to an indefinite future extension.
4. The process must completely separate the solids from the liquid, producing an effluent sufficiently pure to run into a river with a fairly rapid current.
5. The system must be one in which advantage can be taken of any new discovery or invention.
6. The quantity of land required must be small, and the process must be one that can be carried on on the confines of the borough, or within a very short distance.
7. The process must be one into which the commercial element enters as little as possible.
8. There must be no possibility of percolation into wells or springs.

A thorough examination was then made of every known process. Visits, in some cases again and again renewed, were made to what were considered the best and most representative examples of every system.

One of the first results of the Committee's enquiries was the rejection of everything in the shape of land filtration or sewage farming.

These were found to comply with scarcely any of the conditions laid down.

It was found that there was considerable nuisance attached to the process.

That it could not be carried on at all times and seasons; little or no purification taking place in the autumn and winter.

That no advantage could be taken of any new invention or discovery.

That the quantity of land required would be very large.

That the process could not be carried on near the town, there being no sufficient quantity of land for many miles, consequently the sewage would have had to be conveyed a long distance at great cost.

That the commercial element entered into the process to a considerable extent.

And that there was considerable danger of percolation into wells and springs.

The conditions complied with were:—That the system lent itself to indefinite future extension, always supposing there was sufficient land in the neighbourhood of an already established farm.

And that the effluent produced, was sufficiently good to send into a river with a fairly rapid current.

The committee were thus compelled to turn their attention to chemical treatment. Whilst several materials are used, there are, broadly speaking, only two systems of precipitation, the continuous and the intermittent.

The continuous was found to be in operation at a great number of places; the intermittent at only one, namely, Bradford. A careful comparison of the two, showed that the continuous fulfilled a considerable number of the conditions laid down, but that it failed in several which the committee considered vital, whilst the intermittent seemed fairly to comply with all.

Both complied with the first and second conditions, namely, that the process should be carried on without nuisance, and at all times and seasons, but the continuous broke down at the third, not lending itself to indefinite future extension, it being found that if there was an increase in the quantity of sewage one of three things must happen, either that increase must be permitted to run away untreated, or the flow of the sewage through the works must be increased, thus decreasing their efficiency; or there must be a re-construction of the works on a larger scale.

The continuous broke down also at the fourth condition, it being found in every case that there was a considerable quantity of solid matter in the effluent, such being the lightest and very foulest fœcal matter, and resulting from the constant flow being maintained.

The intermittent complied with both these conditions, being capable of any future extension, and in consequence of the sewage having a period of complete rest, entirely separating the solid matter.



Both systems seemed to comply very fairly with the other conditions.

The committee accordingly recommended the Council to adopt the intermittent system of precipitation, as in operation at Bradford, and the engineer to those works, Mr. G. Alsing, was instructed to make the necessary plans, an admirable site of about 23 acres having been secured.

The works have been completed and in operation for about four months. They cover about 7½ acres, and consist of a main building and 30 tanks, each having a capacity of 50,000 gallons, together with an oxidising weir and two filters to each tank.

The process may be said to consist of four parts or sub-processes: subsidence, precipitation, oxidation, and filtration.

The sewage enters the works and flows through four deep subsiding tanks. These act also as catch-pits, and are for the purpose of arresting any floating solids, as well as separating the heavier solids contained in the sewage. The reasons for this separation of the heavier solids are threefold: firstly, the heavier solids form a compost which can be readily and easily got rid of; secondly, the quantity of sludge from the precipitating tanks is thereby reduced; and thirdly, the separation of the heavier from the lighter solids abolishes all nuisance in the drying.

From the subsiding tanks, the sewage flows forward under the floor of the main building, and receives the milk of lime. It then flows through a conveying channel, which serves also as a mixing chamber, where, by a beautifully simple and ingenious arrangement, the lime is most thoroughly mixed with the sewage without the use of any machinery whatever. So intimate is this admixture, that the quantity of lime has been reduced from one ton per million gallons to fourteen cwts., a saving of about one-third. The sewage is then admitted into the precipitating tanks, which are the most important feature of this process (first introduced by Mr. Alsing, at Bradford), and from which it takes its name of intermittent precipitation.

As soon as a tank is full, the flow is shut off, and the sewage allowed to remain completely at rest. The advantages of this method of treatment are very great. By it we are able to get rid of every trace of solid matter, which cannot be done where a constant flow is maintained. The writer has examined large numbers of samples of effluent from works on the continuous principle, and never yet found one which did not contain solid matter. This consists of the lightest and foulest of the fœcal matter, and it is this which decomposes and sets up that secon-

dary fermentation which has been so much complained of in connection with precipitation works.

In the Sheffield works, twenty-five minutes after a tank is filled, complete precipitation has taken place, and the clarified sewage is as clear, bright, and colourless as spring water, and contains not so much as a trace of solid matter.

The importance of the complete removal of the solid matter cannot be over stated, because it permits the subsequent filtration of the effluent by artificial filters to any degree of purity. If the effluent from the tank contains solid matter, as with the continuous system it does, such solid matter gets into the pores of the filter, where it rapidly decomposes, rendering the filters foul and unfit for use. Another great advantage is the removal of the sludge from the tanks every time the effluent is run off, thus preventing decomposition. With the continuous system, the sludge, accumulating sometimes for weeks, decomposes and gives off gases which are taken up by the partially purified sewage flowing over it, rendering the effluent in some cases little better than raw sewage.

The next feature of the works is one entirely novel, namely, the oxidation of the effluent. Oxygen is the great purifier, and to quote the Glasgow report, "if an effluent is brought into contact with oxygen, either by churning it up with air, or passing it over numerous falls, or exposing it in a thin stratum to the air, it speedily becomes inodorous and no longer putrescible." Several methods have been proposed to effect this, one being the pumping up of the effluent and letting it fall in a broad thin stream; another, the blowing of air into it, but all these methods would be costly in practice. The problem has, however, been solved in the Sheffield works, in a very simple manner (the only cost being a slight addition in the construction), by the establishment of weirs, one to each tank. The clarified sewage runs from the tanks in a very thin stream over a weir, with a slight fall, exposing a very large surface to the air. This simple arrangement will play a very important part in the future of sewage purification.

From the weirs the sewage runs through two filters, downward and upward.

The use of filters is a very important matter for local authorities, giving them power to meet any legislative change which in the future may be made.

Supposing a standard of purity to be established by Parliament, and to be higher than is recognised at present, all that is required is to alter the filtering material, to produce any quality of effluent that may be desired, of course somewhat increasing the cost of working.



The filters are so constructed that after a tank is run off the filter used can be completely emptied of liquid and allowed a period of rest, so that the filtering material becomes recharged with oxygen, thus increasing the efficiency of the filter and prolonging its life.

The sludge runs by gravity from the tanks into a collector, from whence it is pumped into open air drying ponds. These ponds are placed at a higher level than the tanks, consequently the supernatant liquid can be run back into the tanks and treated over again. It is found that by thus raising the drying ponds the water is more effectually run off and the sludge got into an easily portable condition.

In the neighbourhood of Sheffield there are large tracts of sandy land which at present will grow scarcely anything. Copious dressings of sewage sludge would be of great benefit to this land, and no doubt is entertained that considerable quantities, if not all of the sludge produced, will be disposed of for this purpose.

The advantages of the intermittent system are:
Simplicity.
Great efficiency.

Small tank area required in comparison with the continuous system, which may be seen from the following table:—

| Daily Flow. | Tank Area. | Tank Area, calculated on basis of uniform daily flow of 10 million galls. |
|---|---|---|
| Continuous. | | |
| Leeds, 10 million galls. | 72,000 sq. feet | 72,000 square feet |
| Coventry 3 „ „ | 33,600 „ „ | 112,000 „ „ |
| Burnley 1½ „ „ | 18,275 „ „ | 122,000 „ „ |
| Salford 5 „ „ | 140,000 „ „ | 280,000 „ „ |
| Intermittent. | | |
| Sheffield 10 „ „ | 55,000 „ „ | 55,000 „ „ |

Economy both of construction and in working.

Perhaps the most remarkable feature of the Sheffield Works is their cost, which has been £32,000.

The working expenses will not be more than £5,000 a-year.

## *On "Municipal Government in its Relation to the Public Health," by* ALD. J. S. ROWNTREE.

No proverbs are more venerable—not to say trite—than those which enforce the uncertain duration of human health and life. The spread of civilization and the growth of knowledge have not materially modified the force of those precepts which counsel men not to "boast of the morrow"—not to say they will do this and that a week or a year hence, forgetful that life and health may not then be theirs. But whilst this uncertainty exists in scarcely diminished force as respects the individual, the growth of historical and statistical science has demonstrated that the probable average health and duration of life, in communities of men, can be presaged with approximate accuracy. On the apparent paradox, that the duration of life and health, whilst absolutely uncertain to the individual, is comparatively certain to the community, has been erected the whole system of life and health insurance.

It has also been established with continually increasing clearness, that the vital and sanitary well-being of a community are capable of being largely influenced, for good or evil, by the action of social, economic, and political forces. In his famous chapter, on the state of the English people in 1685, Lord Macaulay has shown how much the term of human life in this country has been extended since that date, with a corresponding diminution of disease. He mentions that in 1685 one Londoner died in every twenty-three [43½ per thousand], as compared with one in forty [25 per thousand], when the eloquent historian wrote.* In his recently published essay on the progress of the working classes in the last half-century, Mr. R. Giffen has skilfully marshalled a multitude of facts in support of his argument, and amongst these, points to an average extension of life in this country, in recent years, amounting to not less than two years in males, and nearly three-and-a-half in females.†

Writers like those just quoted are chiefly dealing with the vital statistics of the people in their relation to questions of national policy. In the present paper I propose to discuss the humbler theme, of the connexion of local or municipal government with the public health, although it is hardly possible entirely to separate the action of the local from that of the

* History of England, Vol. I., 424.
† Essays in Finance, R. Giffen, Second Series, 386-7.



central government. The local authority is often the handmaid of the central government—the executive hands carrying out the behests of the directing brain. It will not, however, be difficult to establish how influential is the action of municipal government in its relation to public health. I cannot hope to bring forward new facts, or even invest old ones with a charm of novelty for the members of the Congress, familiar as they are with sanitary science. But as one of the objects of this Congress is to increase public interest, and to enlist public opinion on the side of sanitary measures, it may be useful to repeat for a partially popular audience, facts which have become the common-places of experts. This is all I aim at in the present paper. Repeat, repeat, was the dictum of the greatest of orators. Line upon line, precept upon precept, was the motto of prophetic teaching.

In meeting at York, the Sanitary Congress has the advantage of mingling with a population living on a site that has probably been uninterruptedly inhabited for as long a time as any in great Britain. The long history of the City furnishes many illustrations of the progress of sanitary knowledge, and its present condition in the matter of health is a testimony to the value of the science which this Institute labours to advance. I propose in the first place to draw your attention to some of these illustrations drawn from the local history of York, then to glance at the sanitary achievements of some larger municipalities, and in conclusion to indicate some of the paths in which municipal governments may hope yet further to advance the health of their localities.

We know too little of Roman York—Eboracum—to induce us to speculate on its sanitary condition. Here, as in other cities of the Empire, the Romans observed some of the laws of health, which subsequent generations neglected. They interred the dead outside their walls. They sought personal cleanliness through the use of the bath. It may reasonably be assumed that here, as in Rome itself, and as was commonly the case in its provincial cities, laws were in force to secure the cleansing and repairing of drains and sewers, under the supervision of officers closely answering to the public health officers created in this country by recent legislation.

As a great military and ecclesiastical centre, York repeatedly suffered during the middle ages from the ravages of war and pestilence. Its population was subject to the diseases of those times, some of which are now unknown. In the stir of the Crusades, leprosy, which had long existed in Western Europe, appears to have become more frequent, and at a period when the population of this City was only one-fourth or one-sixth as

large as it now is, there were at least five Leper Hospitals located here. They all stood without the City walls.* Leper windows in one or two of the village churches of the neighbourhood, are another indication of the prevalence of this dreadful disease, now happily banished from this country.

Visitors to the City, as they leave the Railway Station, see before them a small cemetery, in which are interred the remains of a number of persons who died from the cholera in 1832. It has been well pointed out by the late Dr. Laycock, that the cholera mortality of 1832, though it excited intense apprehension at the time, was relatively small compared with that of previous pestilences. The deaths were 185. They would have been 9,000 had the epidemic been as fatal as the plague of 1604.† In the report of the Royal Commission on the health of towns, 1844, special attention is drawn to the essay of Dr. Laycock on the health of York. His investigations, say the commissioners, have traced back for upwards of two centuries, the operation of like physical causes, producing different forms of epidemic disease, prevalent under similar conditions, always in the greatest intensity in the same quarters of the City.

The more carefully the plagues of the middle ages have been investigated, the more impressive becomes the evidence of their frequency and malignity. It is impossible to say how often the population of York has been decimated by pestilence. But it must have occurred very many times. With the help of Dr. Laycock's papers, and other materials, I have prepared a chronological table showing the dates of the best known visitations.

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### York Sanitary Chronology.

1349.—The Black Death. In York 17 parish priests died out of 21. In the East Riding 59 out of 105. In the Archdeaconry of the West Riding 119 out of 200. (Seebohm in Fortnightly Review, vol. 2, p. 158.)
1363-68.—Unusual mortality. (Laycock, 250.)
1379.—Great mortality in North of England. (Gent.)
1390.—Pestilence. Sweating Sickness. Gent says 11,000 persons were buried in York this year. (An incredible statement.)
1391.—Pestilence.
1485.—Sweating Sickness appears to have been rife in York before battle of Bosworth, whence it is commonly said to have been spread through the country.
1493.—Sweating Sickness prevailing in York.

* One at Dringhouses, one St. Katherine's Spittal on the west side of the Mount road, one St. Loy's in Monkgate, one St. Helen's in Fishergate, and one St. Nicholas on the Hull road.

† History of England, Vol. I., 424.



1500.—Archbishop Rotherham died of the plague at Cawood, "caught probably at York." (Laycock, 252.)
1550-51.—A Contagious Disease, a "playg of pestilens," exceedingly destructive of human life in York.
1550 & 52.—Corpus Christi pageant suspended on account of the plague. (Davies' York Records, 262.)
1564-5-6.—Observance of pageant again suspended in consequence of "war and sickness."
1604.—"The Great Plague in York." Mortality 3,512 in a population of about 11,000. The Lady Mayoress, Mrs. Thomas Herbert, was amongst those who died.
1631-2.—Outbreak of Plague in York. Wentworth Lord President of the North.
1682.—Water distributed in York through wooden pipes.
1715-35.—Dr. Clifton Wintringham gives the mortality in York as about 1 in 22 of population [45½ per thousand]. 1715.—Small-pox confluent. 1719.—"Putrid Fever," Typhus. 1720.—Influenza and Cholera epidemic. 1721.—Measles epidemic. 1723.—Small-pox confluent. 1725.—Measles epidemic. 1726.—Small-pox. 1728.—"Putrid Fever." 1731-34.—Small-pox.
1757.—Construction of Naburn Locks.
1777.—Dr. White estimated population of York, 12,798, mortality 1 in 28·22 [35½ per thousand].
1832.—Asiatic Cholera, 430 cases, mortality 185.
1844.—Commission on state of large towns. Dr. Laycock's report on York.
1849.—Asiatic Cholera, a slight outbreak.
1850.—Water-works removed to present locality.
1853.—York Sanitary Improvement Act passed.
1872.—Medical Officer of Health appointed.
1884.—Typhoid Fever, about 342 cases, mortality 57.
1885.—Death-rate 17·9 (lowest yet recorded).

The Black Death of 1349 has been shown by a recent author to have fallen with the most signal malignity upon the counties of East Anglia. Its ravages, however, extended to the whole of the kingdom, and in the City of York "it raged furiously from about the Ascension to the feast of St. James the Apostle." (April to July.) Seemingly, three-fourths of the parish priests in York lost their lives in this pestilence. Careful writers estimate that more than half the entire population of the country died. The far-reaching effects of this mortality upon the economic history of England, have only come to be fully recognised in recent years.

Drake, the historian of York, calls the plague of 1604 the last that visited the City, but this is incorrect. There was a visitation in 1631 which possesses features of special interest in con-

nection with the purpose of this paper, from its ravages having been circumscribed by the energy of the local authorities, acting under the strong hand of the President of the North, Thomas Wentworth, afterwards Earl of Strafford. "You have here, under his Majesty," said Wentworth, addressing the Lord Mayor (Robert Hemsworth), "the charge and government of this people, which is to be required at your hands, both before God and man, more especially by myself and this Council, as persons trusted in chief and accountable as well as yourselves; and, therefore, in discharge of my own, not duty only to my master, but my affection also to this town, I do expect that you punctually observe these orders following. Withall, I must tell you plainly, I will inform myself very diligently how they are observed and executed, and shall proceed severely to punish your negligence and others disobedience of them; and that shall Wilson, the chiurgeon, in particular smart for, when it may be he little dreams of it. These are not things to be jested withall."

How the policy of "*thorough*" breathes through every sentence of this letter! The directions which follow were chiefly aimed at preventing the spread of contagion by the isolation of individuals, households, and infected districts. Offenders against the regulations were "soundly whipped," set in the stocks, or heavily fined. Dogs and cats were slaughtered, as supposed to carry the infection. Houses were cleansed. Infected clothes were burnt. The prompt burial of the dead was enforced. The medical remedies were according to the knowledge of those days.* In general terms it may be said

* Precepts prescribed by learned and approved physicians:—

1. "Let those poor people who are afraid to be infected by being employed about the sick, eat butter and bread, with sage, sorrell, or garlicke pilled, in the morning before their employment.

2. "Let them put into their drink ginger sliced, and steep in it the tops of wormweed, first washed and burnt.

3. "Let them shut in their mouths, lettwall, or angellico for want of it, or gentian.

4. "Let them tie upon a stick, poise wise, a little piece of sponge well dipped in white wine vinegar, camphorated, which they may have at the apothecaries.

5. "Let the infected house be perfumed with the perfumes of tar, pitch, or rosin, or juniper wood, and also all their clothes; also let them perfume their houses with vinegar, or rosemary, or bay-leaves.

6. "If any botches, or plague-sores arise, let them use either of these medicines to draw them to a head, and to ripen and burst them, viz.:—Take the roots of white lilies, roast them well in a good quantity of sorrell lapped in a wet paper; then stamp them, and apply them hot to the swelling, and let it lie too twenty-four hours, or apply fresh if need be. But be sure to burn the plaister so taken off, in the chimney fire. Or this: Take a quantity of leaven, a handful of mallows, of sorrell as much, of scabious as much, figgs ten, two injons pilled and sliced; let all these be boiled in old ayle until they come to a soft pultis; stamp it, and apply it hot to the place, thick spread, and this renew every twelve hours, burning it after it is taken off as before said. They may drink, (if they can get it) whigg or buttermilk, but not wey. All the above written directions serve as well (or more proper) for the infected, as for those who are not.

"Mr. Slinger, the apothecary, was desired to make plaisters to apply to the inside of the thighs of such as are in danger of falling sick of the infection, which is thought to be very good for drawing out the malady and malignity of the disease."



the remedial and preventive measures enjoined are similar to those so graphically described by Daniel Defoe in his famous story of the Plague in London (1665). The principal mortality in the York plague of 1631, was outside the walls, in the parish of St. Lawrence. In the City itself the deaths were not numerous. The exemption enjoyed made the citizens very grateful to Wentworth for the singular energy he had put forth on their behalf. A full account of this outbreak of plague, from the pen of the late Mr. Davies, will be found in the report of the Yorkshire Philosophical Society, 1873. It is a suggestive illustration of the successful application of municipal authority, to the furthering of the public health according to the methods of the seventeenth century.

In the early years of the next century, we learn from an essay of Dr. Clifton Wintringham, that the deaths in York exceeded the births by 20 per cent., and annually amounted to about 1 in 22 persons—45½ per 1000. Small-pox, measles, influenza, and malarian fevers, were often epidemic. As the years of the eighteenth century rolled by, the health of the City markedly improved. In 1777, Dr. White, of York, communicated a paper to the Royal Society, in which he gives particulars of the mortality of the previous years. This had now fallen to 36 per 1000, and for the first time for centuries, as Dr. Laycock believes, the births exceeded the deaths. Dr. White attributed this improvement to the widening of streets, better paving, and the construction of new drains, by which the rain water escaped more rapidly, making the houses drier and cleaner. An important event had been the construction of the weir across the Ouse at Naburn, in 1757, by which the river ceased to be tidal at York, and the banks, which had exuded malarian vapours at low tide, were henceforward always under water.

The amelioration in the health of the City continued to advance

throughout the long reign of George III., and that of his successor, and as Dr. Laycock says, "when the epidemic cholera first appeared in England, in 1832, the sanitary condition of York was still low, although when compared with that of the previous century, it was improved to an extraordinary degree."

Dr. Laycock gives the following table of the rates of mortality in York in the eighteenth century. Having regard to the imperfect registration of the period, the figures must be received with some caution.

TABLE *showing the progressive improvement in the health of York since the commencement of the last century.*

| PERIOD. | No. of Deaths. | Population. | Per-Centage of Persons Dying *under* 5 Years of Age. | Per-Centage of Persons Dying *above* 5 Years. | Per Centage of Persons Buried aged above 70. | Average Age of Persons Buried. | Inhabitants to one Death. |
|---|---|---|---|---|---|---|---|
| | | | | | | | 21·77 |
| *a*1728 to 1785 | 3,486 | 10,800 | ..... | ..... | 16·5 | 28·34 | 28·22 |
| *b*1770 to 1781 | ... | 12,798 | 38·6 | 61·3 | 14·67 | 30·52 | 32·08 |
| 1781 to 1791 | 4,388 | 14,079 | 37·92 | 62·08 | 14·44 | 30·64 | 32·33 |
| 1791 to 1801 | 4,991 | 16,145 | 37·13 | 62·87 | 13·54 | 29·36 | 33·84 |
| 1801 to 1806 | 2,538 | 17,181 | 35·83 | 64·17 | 15·55 | 30·90 | 35·72 |
| 1806 to 1811 | 2,592 | 18,217 | 37·30 | 62·70 | 17·71 | 30·47 | 40·70 |
| 1811 to 1816 | 2,395 | 19,502 | 33·84 | 66·16 | 16·62 | 31·4 | 40·56 |
| 1816 to 1821 | 2,557 | 20,787 | 35·88 | 64·12 | 15·82 | 32·56 | 44·51 |
| 1821 to 1826 | 2,643 | 23,523 | 36·23 | 63·77 | 13·04 | 29·39 | 43·30 |
| 1826 to 1831 | 3,033 | 26,260 | 36·87 | 63·13 | ..... | 32·21 | 37·77 |
| 1839 to 1841 | 2,398 | 30,152 | 42·16 | 57·84 | | | |

*** The average annual mortality of each of the periods in this table, is considered as representing the mortality of the last year of the period, on the population of which, the ratio of persons living, to one death annually, is calculated. The percentages are from 26,000 deaths in the parish registers.

*a*. This estimate is on data from "Drake's History of York."

*b*. From data published by Dr. White, of York, in the 72nd volume of the "Philosophical Transactions."

The outbreak of cholera in 1832, stimulated many sanitary measures, carried out at that time by the City Commissioners, whose powers were subsequently vested in the Corporation. In 1850, the water supply drawn from the river Ouse was enlarged and improved by filtration. In 1853, an important Sanitary Improvement Act was obtained, by which the sewage discharging itself into the river Foss, was intercepted and taken into the Ouse. This costly undertaking, to defray the expense of which a special rate was borne by the citizens for 30 years, is believed to have been attended by excellent results. In 1872, the Corporation appointed a Medical Officer of Health. It has subsequently erected Public Baths and a Fever Hospital. Concurrently with these measures, the annual death-rate has been lowered nearly 2 per 1000 in the last 10 years, and the mortality of



the City is now as low as the average of urban communities in England and Wales. Still it is higher than could be desired. In 1884, an outbreak of typhoid fever excited considerable apprehension, and since that time the drainage system of the City has received much consideration from the Medical Officer of Health, and is at the present time the subject of a special inquiry by direction of the City Council. I subjoin the annual statistics of births and deaths in York since 1874, also a Table showing the mortality from certain specified diseases, for the same period, taken from an exhaustive report by Mr. North, presented to the Council in February, 1885, which contains full information on the recent sanitary state of York. (For Table see page 205.)

We will now leave the City of York with its comparatively small population, and glance at the recent experience of the great commercial community living on the banks of the Clyde.

The City of Glasgow can present a particularly interesting record of the sanitary benefits its inhabitants have enjoyed, by the intelligent vigour of its municipal government. Amongst the agencies which have ameliorated the condition of Glasgow, its unrivalled water supply stands prominent. Upwards of £2,000,000 (£2,202,789) have been spent in bringing the water of Loch Katrine to the 750,000 people living in Glasgow. But this outlay (large as it sounds), has secured a bountiful supply of water almost absolutely pure, clear to the uttermost and without colour, at a less cost to the community, than that of most of the great cities of the Empire. Five and twenty years ago, it was estimated that through the purity and softness of this water, the Glasgow people saved £40,000 per annum in soap and tea alone. The Corporation of Glasgow published last year a volume of 304 pages, drawn up by the City Chamberlain, James Nicol, Esq., giving in detail the vital, social, and economic statistics of the City.* These figures, says Mr. Nicol, show that in the ten years ending with 1884, 600 lives per annum were saved in Glasgow, which would have ended, had the people died as fast as in the ten years ending with 1874. The whole lessened mortality of the decade must represent a population, now living, equal to that of the town of Malton. This diminution of mortality has largely resulted from the specific measures taken for the prevention of fever since 1869.

* Other Corporations might do well to follow the example of Glasgow in publishing facts relating to their administration. The inhabitants of a locality are often very ignorant as to what their municipal rulers are doing. Great service may be rendered to sanitary work by keeping the public mind informed, through the local newspaper press and otherwise, as to the measures which a municipality is carrying out, the reasons for them, and their results when finished. Books like this of Mr. Nicol's nurture an intelligent local patriotism.

About that time the Health Committee addressed themselves vigorously to ascertain the causes of the prevalence of fever, and if possible to remove them. In 1869, 1256 deaths were registered from different kinds of fever, typhus claiming 970. In the last four years the deaths from fever have never reached 300, and for ten years the annual mortality from typhus has been under 100. Mr. Nicol tells us that it was clearly shown that insanitary conditions originated the pestilence, and that once generated it spread rapidly from house to house, from court to court. Isolation, followed by fumigation, was found to be the surest way of preventing the spread of the fever. The compulsory powers for securing this, and carrying out other sanitary measures were put in operation. At first the vigour of the health officers excited opposition, but this was surmounted, and now every one recognises their high aim and submits to their administration.*

Mr. Nicol supplies the following statistical information as to the fever mortality in Glasgow for the past eighteen years:—

GLASGOW.

*Febrile Mortality in past eighteen years.*

| YEAR. | Typhus Fever. | Enteric or Typhoid Fever. | Relapsing Fever. | Simple Continued Fever. | Infantile Remitting Fever. | Rheumatic Fever. | Total of each year |
|---|---|---|---|---|---|---|---|
| 1867 | 497 | 202 | 7 | 16 | 26 | 17 | 765 |
| 1868 | 367 | 229 | 5 | 16 | 41 | 13 | 671 |
| 1869 | 970 | 221 | 12 | 9 | 31 | 13 | 1256 |
| 1870 | 544 | 152 | 113 | 12 | 27 | 6 | 854 |
| 1871 | 286 | 180 | 247 | 19 | 25 | 15 | 772 |
| 1872 | 161 | 206 | 37 | 5 | 20 | 11 | 440 |
| 1873 | 79 | 285 | 5 | 12 | 24 | 18 | 423 |
| 1874 | 114 | 202 | 7 | 10 | 11 | 20 | 364 |
| 1875 | 96 | 252 | 3 | 11 | 19 | 24 | 405 |
| 1876 | 82 | 196 | 8 | 14 | 22 | 25 | 347 |
| 1877 | 77 | 170 | 2 | 1 | 11 | 12 | 273 |
| 1878 | 50 | 198 | 2 | 7 | 9 | 18 | 284 |
| 1879 | 58 | 134 | ... | 10 | 9 | 32 | 243 |
| 1880 | 43 | 279 | 1 | 19 | 6 | 40 | 388 |
| 1881 | 50 | 175 | ... | 11 | 12 | 44 | 292 |
| 1882 | 32 | 177 | 1 | 9 | 6 | 40 | 265 |
| 1883 | 53 | 176 | 1 | 13 | 1 | 47 | 291 |
| 1884 | 32 | 199 | ... | 9 | 5 | 34 | 279 |
| Total of 18 Years. | 3591 | 3633 | 451 | 203 | 305 | 420 | 8612 |
| Average of 18 Years. | 199 | 202 | 25 | 11 | 17 | 24 | 478 |

* Vital, Social, and Economic Statistics of the City of Glasgow. Robert Maclehose, p. 46.



If time had allowed, it would have been interesting to have described some of the other works which have been carried out by the Corporation of Glasgow. Something of the magnitude of its administration can be surmised from the growth of the municipal revenue from £15,340 in 1844, to £1,186,278 in 1885. I cannot, however, stop to speak of the removal of old and dilapidated property, of the elaborate system by which the City is cleansed, of the parks, markets, or libraries, or of the wonderful growth in the navigation through the deepening of the Clyde. These are characteristically set forth, in much detail, in the volume I have referred to. Whilst her municipal government is thus administered, Glasgow will have no need to fear that the motto of the burgh will grow obsolete —"Let Glasgow flourish."

Visitors to Birmingham at the recent meeting of the British Association, were furnished with a particularly well-written hand-book of information about the capital of the Midlands. From the preface I copy one paragraph referring to the achievements of the Corporation, in respect to the health of the town:

"Immediately after the passing of the Public Health Act, 1872, the Borough was constituted an Urban Sanitary District, and the Council, as the Urban Sanitary Authority, set itself vigorously to the work of improving the public health. A Borough Hospital, for the treatment of small-pox and scarlet fever, was established in 1874. The Public Health Act, 1875, indirectly removed, for sanitary purposes, the limit on rating powers to which the Council were obliged to submit in their Act of 1851. By the zealous labours of the Health Committee, and the liberal application of the pecuniary resources placed at its command by the Act of 1872, the death-rate has been reduced from 24·8 per 1,000 in 1874, to 19·1 in 1885, although the mean density of the population has increased in the same period 20 per cent."

It would be easy from the history of other English municipalities, to relate achievements not less striking than those I have drawn your attention to. But this is unnecessary and might be tedious. The experience of York, Glasgow, and Birmingham, may be taken as representative examples, all showing how much is in the power of local governments to effect for the health of the people. We will now turn from the records of the past, to consider the means whereby in the future municipal governments may best promote the public health. For it would be a great error to suppose they have reached the limits of their powers, although when one reviews the sanitary history of our ancient cities, or the more recent achievements of our

foremost municipalities, one is struck with the great advance which sanitary knowledge has made. I hardly exaggerate in saying that sewage has become one of the most popular questions of general conversation. The widespread interest now taken in sanitary matters meets you in unexpected quarters. Visitors to schools and other public buildings, will often exhibit as much interest in the drains as any part of the structure. In the recent political discussions on the government of Ireland, the high death-rate of Dublin has done duty as an argument against giving increased powers of government to people who did not employ those they already possessed to keep their own population in health. Localities have learnt that disease and death are costly. A high death-rate is a distinct loss to a community. The British watering-places vie with each other in endeavouring to show from statistical data, their own superior salubrity. One corporation has, we believe, circulated instructions for the proper bringing up of infants. Another made an inquiry into the causes of juvenile mortality, when the registrar's figures disclosed deaths in excess of those of competing watering-places, and discovering a reprehensible habit amongst its constituents of feeding infants on kippered herrings and gin, endeavoured to dissuade parents from supplying a diet so injurious to their children, and so detrimental in its results to the good name of the town. When an outbreak of fever occurs, the popular voice at once demands the presence of an inspector to track out the cause, and public meetings are held to incite the local authorities to increased vigilance in cleansing the streets, flushing the drains, and removing nuisances. A former generation would have marked the cessation of a pestilence by erecting an altar to an unknown god. It is an immense gain to the cause of sanitary science that the popular mind has been imbued with a belief in the connexion between many forms of disease and removable causes. A great deal has been achieved when popular opinion has been enlisted on behalf of the measures needful for the public health. When the people see that these measures are for their own good, and the good of their children, our popular municipal governments become the strongest of all governments for the attainment of the desired ends. From the sanitary standpoint they realize President Lincoln's ideal—government of the people—by the people—for [the health of] the people. To an intelligent population, its municipal government becomes the authoritative expression of its wishes in sanitary affairs. Hence the great importance of the *personnel* of our municipal bodies. If the connexion between a healthy population and good municipal government were yet more generally recognised, a more widely



diffused and a more intelligent interest would be taken in the selection of councillors than is now the case. This would show itself both in the choice of candidates, and in inducing fit men to be willing to take the appointment. In some localities municipal office is honoured, and is an object of ambition to able and educated men. In other places, it is too much the fashion in the educated circles to reckon the office of councillor or alderman, *infra dignitatem*. When a corporation has been elected how may it best serve the sanitary interests of its constituents? You may assume that all its members would rather see their locality healthy than unhealthy. It is also safe to assume that there will be a considerable number who have but little knowledge how this is to be brought about. The main work of a corporation is done by its standing committee. You want public spirit amongst its members, and a sense of responsibility to the population they represent, which shall secure upon the health committees the presence of those members who have special acquaintance with the subject. Then beyond this, I should attach extreme importance to the selection of your permanent officials. Unless a corporation is well sustained by its officials, its work will fail. Why? Because a corporation and its committees are always changing—but its officials are permanent. You may have the most intelligent committees. They may arrive at the wisest conclusions. These may be recorded on their minutes. The committee breaks up and disperses. When it meets in a fortnight's time, it may be to find its directions have not been carried out at all—or carried out too late—or in an imperfect manner. This is what constantly takes place when the administration of a public body is in the hands of inefficient officers. Then how shall you secure good officials? (1) By paying adequate salaries. (2) By the maintenance of a public spirit in the appointing body, which will demand efficiency as the supreme qualification for appointment. If a corporation selects its health officer—not because he is a man capable to deal with sanitary affairs—but because he is the personal or political friend of a majority, it will but too surely pay the penalty—it may be in years of inefficient work. It is no exaggeration to say the sickness of hundreds of people, the deaths of scores, may follow as the direct or indirect result of one unsuitable appointment. You can hardly be too careful also in the selection of your subordinate officers in the same department. These men obtain a specialised knowledge of questions of drainage, often exceeding that of able architects. I have personally known architects' plans most faulty, which before their execution have been made good by the suggestions of nuisance or buildings inspectors. These

men should work under kindly efficient oversight. Temptations are placed in their way to pass scamped or incomplete work. England expects every man to do his duty, but unfortunately there are always some English builders who do not know their duty, and some it is to be feared who know it, but do not wish to do it. In one nice looking house, not fifty miles distant from where we are now assembled, a soil pipe was recently found to have been conducted into a rain-water cistern used for household purposes. In a street known to many present, the drainage had been arranged on the intelligent supposition that water is accustomed to run up hill. Now these are the details which require ceaseless vigilance, and to which no corporation can attend except through its officials. When you get efficient and conscientious men in these departments, even if you pay high salaries, they may be extremely cheap to a community. Fill them with inefficient men, and if you paid them nothing, they would be intolerably dear.

The difference of a few pence in the rates of a locality makes but little difference to the majority of the population, in comparison with the cost of disease. The abolition of a 6d. rate would be a great event in municipal finance. It would save the majority of ratepayers 6d. to 1s. a month. But an outbreak of preventable disease quickly costs the poorest many sixpences and many shillings, irrespective of the sorrow and suffering that follow in its train. Yet, all public expenditure, even in the interests of health, should be thrifty and economical. Lavish expenditure may go hand in hand with inefficient administration. And it should never be overlooked that a population is always liable to forget what it is receiving from its sanitary guardians, whilst the cost of their services it never forgets. The averted fever, the escape from small-pox, are not thought of: the rate collector always asserts his presence. If his visits become too frequent and too onerous, they are liable to provoke a reaction against measures urgently required for the public weal.

I have spoken hitherto, chiefly of municipal administration in relation to health. There is outside this the wider question of general municipal policy. Should a municipality limit the sphere of its activity within the narrowest limits prescribed by the general law of the country, or should it take a wider and more comprehensive view of its responsibilities? Experience indicates, I think, rather decisively that the latter is the wiser policy. If the work of a corporation is small it excites but little public interest. It is liable to fall into the hands of an inferior class of men. On the other hand, where the work is important and interesting, it attracts to it able men. It is difficult to impress the popular imagination with small questions of drainage, inspection of nuisances, the prevention of adulteration—most important as these things are. But where a municipality concerns itself in addition with providing parks, or places of recreation for the people, beautifying the public roads with trees, as well as cleansing and watering them, taking charge of the water supply as being a requisite of life, to be so administered as shall promote the health of a population rather than the profit of shareholders; where it has charge of great public libraries open to the entire population, in which amongst other literature, the best works upon sanitary science lie open before the poorest citizen equally with the wealthiest; where baths, wash-houses and fever hospitals are maintained for the enjoyment of the healthy and the recovery of the sick—though these things cost money the people feel that they are their own property, and it is found that such a policy best promotes the material interests of the locality, as well as the health of its inhabitants.



In the formation of sound public opinion on these subjects, the annual gatherings of this Sanitary Congress may be of very great use.

Before concluding, I must briefly advert to one matter of cardinal importance, in which municipal life touches the public health to some extent directly, and to a still greater extent indirectly. The health of the British people probably suffers more from their intemperance in the consumption of alcoholic beverages, than it does from bad drainage, impure water supply, or insanitary buildings. Municipal life connects itself closely with the social life of the community. The drinking of healths is a popular department of municipal activity. Multitudes have ruined their own health through drinking the healths of other people. Sir WILLIAM GULL says:—"A very large number of people in society are dying day by day poisoned by alcohol, but not supposed to be poisoned by it." Sir ANDREW CLARKE says:—"I looked at the hospital wards to-day and saw that seven out of ten owed their disease to alcohol." It has been ascertained that the class of the community most liable to the frequent taking of alcoholic liquors—licensed victuallers and innkeepers—are amongst the most short lived. They die in the ratio of two to one of the Protestant clergy, and as five to three of grocers, game-keepers, and farmers. In view of facts like these, which are capable of indefinite extension from the records of sick clubs and insurance offices, no one interested in sanitary science can rightly be indifferent to the claims of the temperance movement. The progress it has made has already lessened the amount of sickness and death in the community, but the

continued prevalence of intemperance is every day carrying many victims to the grave. Opinions will still continue to differ how this giant evil may best be grappled with. The advocates of total abstinence believe they have no occasion to be ashamed of their faith and practice, and the adherents of strict moderation can advance weighty arguments in support of their position. It is no part of the purpose of the present paper to discuss the respective claims of abstinence and moderation, but it would have been a grave omission to have made no reference to a subject at once so closely related to municipal government and to the public health. Municipal corporations have considerable power in the appointment of the magistracy, the present licensing authority, and they have a still greater power in influencing the social customs of the community. The members of corporations who would worthily fill their part as custodians of the public health, will not overlook their responsibilities in relation to the use of an article, which is practically so great a foe to the welfare and happiness of mankind. I gladly bear testimony to the increased interest that has been shown of late years in this subject, and to the marked improvement in the customs of society in relation thereto.

The argument of the present paper has been so simple, that it is unnecessary to employ many words in summing up. The facts adduced clearly show how strong is the influence which municipal governments can exert on the health of communities. The great improvement in the public health, which has been in progress for a long period, and is continuous to the present time, is to no inconsiderable extent attributable to the vigilance of our municipal governments. At the same time, the measure of past success should only be an encouragement to further and more intelligent labour in the future. I have endeavoured to indicate both the general municipal policy and the character of the administration, which promises the largest harvest of useful results in future years. The drift of public opinion in this country is favourable to enlarging the powers of local authorities. Should this increase of power be granted, and should it be exercised on the lines I have endeavoured to lay down, we may anticipate the best results to the health of the British people; —and whilst this paper and the proceedings of this Congress relate to physical health, the subject grows in importance, when it is remembered how intimate is the relationship between physical, intellectual, and moral health.

[*For discussion on this paper see page* 218.]



TABLE *showing Births, Deaths, Birth-rate, Death-rate, and Deaths from Zymotic Diseases in the City of York for the Twelve Years ending* 1885.

| Year. | Estimated Population. | Total Births. | Total Deaths. | Deaths under One Year. | Deaths under Five Years of Age. | Deaths from Small-pox. | Deaths from Measles. | Deaths from Scarlet Fever. | Deaths from Diphtheria. | Deaths from Whooping Cough. | Deaths from Typhoid and other continued Fevers. | Deaths from Diarrhœa. | Deaths from Total deaths from the Seven Principal Zymotic Diseases. | Birth-rate. | Death-rate. | Death-rate of Urban Districts in England and Wales. | Deaths under One Year to 1,000 Births. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1874 | 45,443 | 1604 | 1041 | 293 | 440 | .. | 20 | 21 | 4 | 25 | 18 | 70 | 158 | 35·2 | 22·9 | 24·2 | 183 |
| 1875 | 46,005 | 1572 | 1091 | 285 | 418 | .. | 3 | 9 | 2 | 49 | 29 | 73 | 165 | 34·1 | 23·7 | 24·2 | 181 |
| 1876 | 46,575 | 1644 | 906 | 241 | 350 | 1 | 3 | 14 | 5 | 13 | 17 | 82 | 135 | 35·2 | 19·4 | 22·6 | 146 |
| 1877 | 47,151 | 1691 | 1048 | 263 | 411 | .. | 30 | 46 | 7 | 3 | 6 | 53 | 145 | 35·8 | 22·2 | 21·8 | 155 |
| 1878 | 47,735 | 1732 | 1070 | 313 | 477 | .. | 2 | 19 | 5 | 35 | 12 | 90 | 163 | 36·2 | 22·4 | 23·4 | 180 |
| 1879 | 48,326 | 1664 | 1094 | 265 | 399 | .. | 7 | 32 | .. | 26 | 10 | 37 | 113 | 34·4 | 22·6 | 22·1 | 159 |
| 1880 | 48,924 | 1657 | 1097 | 294 | 469 | .. | 17 | 22 | 2 | 23 | 18 | 152 | 234 | 33·8 | 22·4 | 21·9 | 178 |
| 1881 | 49,530 | 1634 | 943 | 232 | 351 | .. | 1 | 30 | 6 | 15 | 23 | 44 | 119 | 32·9 | 19·0 | 20·3 | 141 |
| 1882 | 50,142 | 1627 | 1066 | 311 | 489 | .. | 44 | 22 | 3 | 37 | 14 | 73 | 193 | 32·4 | 21·2 | 21·2 | 191 |
| 1883 | 50,764 | 1620 | 1027 | 257 | 351 | .. | .. | 14 | 4 | 11 | 17 | 53 | 99 | 31·9 | 20·2 | 20·8 | 158 |
| 1884 | 51,392 | 1668 | 1102 | 305 | 441 | .. | 38 | 38 | 2 | 4 | 57 | 76 | 215 | 32·4 | 21·4 | 20·9 | 182 |
| 1885 | 52,020 | 1521 | 936 | 232 | 352 | .. | 3 | 8 | 1 | 46 | 7 | 30 | 95 | 29·2 | 17·9 | .. | 152·5 |

NOTE.—The figures given in this Table refer to the City *before* the Extension of the Boundaries, and do not include any part of the added area.

*On "An Account of an investigation into the classes who administer the Public Health Act," by* T. HARNETT HARRISSON, Assoc.M.I.C.E.

OPINIONS expressed at these Congresses as to how the Public Health Acts work and how they fail to work, have led to an attempt being made to obtain some further information about the classes who administer them. Discussions on the subject seem to shew that the Public Health Acts are fairly efficient, and that the officers appointed under them are mostly good ones. But that these officers are often hindered and thwarted in their efforts to carry out the duties to which they are appointed, and that they are so hindered and thwarted by a system that prevails, to some extent, in the majority of places where Boards of Health are established.

This system when it gets its right name is called "jobbery," and jobbery means the doings of men who use their official position for, and turn official action to, their own advantage. The initiated in such matters, know that there are men who get elected as members of sanitary boards for the sole purpose of practising jobbery, while some consent to the practice of it, in obedience to pressure put upon them by other members or by persons outside to whom they are bound by monetary or similar interests. There are a large number of men supposed to be elected to their positions to work for the "public good," who if they understand the phrase "public good" at all, would regard acting from such a motive as simple stupidity; their whole philosophy is summed up in the words "*number one*," and their action is regulated by that single idea.

There are, also, many honest public spirited men elected to sanitary boards, having every wish and intention to further all that is good, but they often find themselves in a minority, and either remain to fight a hopeless battle against jobbery or retire in disgust. There are also some sanitary boards which carry out the powers given to them by the Public Health Acts, in a manner beyond criticism or praise.

The framers of these Acts do not seem to have sufficiently provided for the fact, that "there's a deal of human natur' in man." If it were not for this human nature, laws would not be required at all, but since men have to administer the laws made to counteract their own imperfections, provision for the proper administration of laws is quite as necessary as making the laws themselves.



The object of this enquiry was to discover how far the absence of such a provision has been taken advantage of by those whose self-interest is opposed to the operation of the Public Health Acts.

It was thought that a man's business and position in life are excellent indications of what his worldly interests are with regard to such a matter as that under consideration, and that his interests are good guides as to what his line of action will be. With the object, then, of obtaining information as to the business and position in life of the administrators of the Public Health Acts, circulars were addressed to the Medical Officers of Health of eight hundred of the urban sanitary authorities of England and Wales, asking the profession and position of the members of their Boards, and for any remarks they would kindly make.

Of these 800 circulars, 202 were returned with the information asked, 29 were returned without any information, and 569 are now languishing in the oblivion of waste-paper baskets.

Although it is to be regretted that 598 medical officers of health, no doubt for very good reasons, declined to reply, the 202 who gave the information sought did so with great courtesy, sometimes accompanying it with remarks of considerable pith and offers of further information. To this faithful few we owe our best and most sincere thanks, as it is thought, that, from the returns they made, and the remarks which in many cases illuminate them, interesting information and some food for reflection may be gathered.

In the case of 37 circulars sent out, the additional request was made that the letters P. O., meaning property owners, should be placed opposite the professions of the members of the boards.

It is to be regretted that this request was not made in the case of all the circulars, as the returns made having this addition yield the most valuable information. The 202 sanitary authorities of which returns were made are composed of 2796 members, and these are readily divisible into 22 classes, and of these 22, there are only 9 classes numbering more than 50, but it will be seen that the administration of the Public Health Acts is virtually in the hands of four or five classes. In order that some idea may be formed, as to the attitude of these classes with regard to sanitary progress, it is thought that the most profitable course will be to consider them separately.

The nature and effect of the action of builders upon Boards of Health is pretty well understood, and is almost universally objected to by sanitarians, on the ground that their building operations cannot be controlled by the sanitary officers, since the

sanitary officers in this case have to control the sanitary (or unsanitary) authority, the servant to control his master, and this position of things of course applies to all other cases where members of such boards oppose sanitary work.

The builder members of sanitary boards generally get elected in order that they may build cheaply and in defiance of the law. The result is that the public health is often sacrificed in order that a paltry sum of money may be retained in the pockets of men appointed to promote public health. A body of men who are elected by their fellow men to save life turn round and kill their electors for a small fee. And one is inclined to say it serves the electors right, since the public is entirely responsible for the presence of builders on Boards of Health and for the kind of dwellings they erect. It cannot be said of the speculative builder that he is an instance of the survival of the fittest; he, however, seems to be a product of natural selection, since he has been developed to his present state of imperfection by surroundings which he has accepted as being of material advantage to himself. People are never tired of abusing the speculative builder who has erected their defective dwellings, but the public have not only themselves created him, but have proceeded to elect him as the guardian of their health. When people are willing to give a fair rent, purchase money, or mortgage money for a well-designed, well-built, and sanitary house, of a size in proportion to the price, the speculative builder, as we now know him, will die out, and a better stamp of man will take his place. What people now want in a house is display, not a convenient or healthy home.

It is thought that a great deal of education will be required before sound sanitary houses will be selected rather than showy, cheap, and nasty ones of larger size. At present the jerry builder flourishes upon the snobbish wish of Mrs. Roe to outsnob the snobbishness of Mrs. Doe. Although sanitarians look upon builders as such great obstructionists, they do not appear, from the returns obtained, in great numbers upon Sanitary Boards. Out of the 202 from which returns were obtained, 101, or one-half only, are blessed with their presence. Out of 2,796 members of Boards of Health under consideration, 212 of them are builders, or about $7\frac{1}{2}$ per cent. There are only $4\frac{1}{8}$ per cent. of builders serving upon Sanitary Boards returned as property-owners. As we know he builds to *sell*, and some of his purchasers belong to classes largely represented with him upon Boards of Health.

The following are remarks made by Medical Officers of Health:—

1. "I feel a deep interest in the work of sanitation, and have pleasure in giving the information you seek. I deeply deplore that builders should obtain seats on health boards. I deeply deplore the terrific rate of infant mortality in my district, and would help in any way possible to reduce it."

2. "Of course builders of cottage property are well represented."



Of all classes serving as members of sanitary boards, the shop-keepers are by far the most numerous. They appear upon these returns to the extent of 30·84 per cent. of the whole number. It would not at first be thought that as a class they are directly interested in opposing the Health Acts. But they appear as property owners in the third degree or to the extent of 11 per cent. of their number. This class, perhaps, is the least independent of any; they rely almost entirely upon popular favour and goodwill for their prosperity in life, and are, it is thought, more than any class under the influence of those who can be important friends or damaging enemies. It is to be expected that they would from these motives take at least a negative position with regard to any cause requiring both outlay and fighting to secure its advancement. There are, however, many among them who are offenders against the Health Acts. Cottage property is a favourite investment with the shop-keeping class, and the thriving ones frequently drift into the gentlemen class, when they own enough of it to live upon the rentals. To become a member of a local board is a cheap means of gaining importance, and when the envied position is attained, profit comes with the popular favour that can readily be achieved in a money-getting and money-keeping community, by opposing all work, good or bad, that involves outlay and higher rates. But to men of independent position these things have no charms; they are, on the contrary, repelled by the fact that small jobbers are attracted.

The following are some remarks by Medical Officers of Health:—

1. "It is impossible to work, one is always under the thumb, and subject to, the spites and spleen of the pettifogging men who form the Board. The appointment ought to be entirely in the hands of the Local Government Board. Then one could do good honest work without being kicked out every twelve months."

2. "The men who form the Board are all small in every sense of the word, none of the leading men will sit on it."

3. "There has been a great falling off in the social status of Sanitary Authorities since the passing of the Public Health Acts in 1875."

4. "As for the members they consist of tradesmen of the

town, who are chary of spending a penny in the way of improvement."

5. Where there are 16 shop-keepers out of the 24 members, the remark is:—"I do not believe that the very smallest fraction of those constituting the Board do so for the sake of sanitary matters, it is more to get their names before the public, and have the handling of public affairs. The Medical Officer's Report is read, and no discussion is ever made upon it. The subject of their meeting is generally some wrangle about the Town Hall clock, or other equally absurd subject."

6. "My district is not so sanitary as it should be, there is no doubt it is useless to recommend as the Board never carry out my suggestions."

7. Where there are six shop-keepers and a manufacturer out of nine members, the Medical Officer of Health says, "Personal interest always above sanitation."

8. In a case where the chairman is a baker, the remark is,—"He is a business man and anxious to carry out sanitary improvements."

9. Where the Board is composed of 16 shop-keepers, 3 builders, and 2 building tradesmen, the Medical Officer of Health says—"Here as elsewhere really intellectual and intelligent men keep entirely aloof from municipal affairs."

10. In a board of 16 the Medical Officer of Health marks 6 and says,—"Those marked are very good members. The majority are not men of any position in the town. They have gradually withdrawn."

11. "Unless Boards of Health are composed of men of independence and free from local pressure, I am convinced that it is impossible to work any great sanitary reform."

Manufacturers are very strongly represented upon sanitary boards, they number 17½ per cent. As a class they may it is thought be fairly ranked with those whose interests directly clash with sanitary work. Among their numbers are chemical manufacturers, tanners, bone boilers, fellmongers, glue makers, manure makers, fat refiners, brick makers, dye makers, candle makers, soap boilers, gas makers, and others too numerous to mention, the nature of whose operations are such as to pollute our water, and load the air of our populous places with noxious gases and smoke.

The constant litigation brought about by the nuisances they create, and the special provisions in the health Acts made by Parliament to regulate and control their works, is pretty good evidence that manufacturers are not a class calculated to make good administrators of the health Acts; while on the contrary they are eminently fitted to make formidable enemies to sanitary reform when so inclined.



They are a very powerful class, in that they are wealthy, they pay the working population of towns their wages and command votes. They can arrange that the medical officer of health shall or shall not act as doctor to their workmen.

They are probably among the worst and most numerous offenders against the public health.

But we find that next to the shop-keepers they are the most numerous of all the classes serving upon sanitary boards.

They are also of all classes the largest property owners, 16 per cent. of them appearing under that head, and their property largely consists of cottages inhabited by their own workmen.

Is it not natural that this class, considering the great stake generally involved, should use their power for the purposes of self-defence? If the builder's interests are sufficient to make him so potent an enemy of sanitary work, what is likely to be the effect of the enormous interests of the manufacturers?

Remarks of Medical Officers of Health:—

1. "This Health Committee takes very little interest in sanitary matters. It seems to be the opinion of the Committee that the less fœcal matter in tanks is disturbed the better, because it stinks most when it is disturbed."

In one case there are nine manufacturers out of twelve members, and the remark is:—

2. "The only difficulty we have in one district is from the agent of large works, who refuses to carry out improvements in the sanitary condition of houses of his company. The chief of the rates come from this company."

3. "Clauses as to smoke not enforced; members, who are chiefly manufacturers, will not agree that it is injurious."

4. "The chairman of the Sanitary Committee is a fell-monger."

Gentlemen appear from the returns to serve on Health Boards to the extent of about 11¾ per cent. The word gentleman formerly meant a man of gentle or noble birth—one who, not being a member of the nobility, had a right to bear arms.

This definition has, however, gradually widened, until to-day a retired scavenger would feel deeply wounded if he were not spoken of or introduced as "this gentleman," so that the appellation, as used by the majority, has ceased to be a complimentary one, except that it is intended to convey that the man to whom it is applied can afford to live without working. And this is what it means to a large extent in the case of these returns. It does not, however, mean that jobbery shall be considered as work, or that the jobber forfeits his right to the title. All the members of Health Boards have been classed under this head who live upon their means, whatever may have been their former occupation. They largely consist of retired trades-

men, and 13 per cent. of them are property owners. It would, of course, be absurd to imply that there are not many among them who are gentlemen, in the best and highest sense of the word, and who, as members of Sanitary Boards, work solely for the public good.

But, as a class given in these returns, they are, it is thought, not generally to be considered the friends of the Health Acts. They are of all classes except one the largest property owners.

Remarks of Medical Officers of Health:—

1. "I mean by 'gentlemen' men who have gained a competence and are living on it."

2. In one return the chairman is classed as a gentleman, and a note after his name says, Plumber, now out of business.

3. Opposite one member it says, "Mr. ——, Gentleman—Druggist and Quack—Chairman."

4. "Gentleman, means retired from position in a haberdasher's shop; holds some very poor dwelling-houses."

5. As you will probably surmise, most of those notified under the term "gentlemen" are retired tradesmen.

Merchants appear to the extent of about 8¾ per cent.; they are property owners in the fourth degree, or to the extent of 7 per cent. of their numbers, otherwise it is thought that they are calculated to make good administrators of the Health Acts, as being comparatively independent of the immediate locality in which they live, as being good men of business, and to a large extent free from prejudice. The property they own is not generally poor, except in the case of timber merchants, who have to annex that of speculative builders for bad debts. The timber merchant, too, is likely to be to a considerable extent under the influence of the builders.

Taking them as a whole, however, it is thought they make good administrators of the Health Acts.

There are 89, or about 3¼ per cent. of doctors serving upon sanitary boards.

The interest of doctors appears to be that people should neither die or live healthily. The doctors' ideal population, assuming fees to be his first object in life, would probably be one made up of wealthy "chronics," just ill enough to make his attendances necessary, and yet quite well enough to live to a good old age. It has been said that to some doctors their profession is a heavenly goddess, while to others she is only the cow that gives the milk. It is sincerely believed that the majority of them are more or less goddess worshippers, and that the cow-keepers are few. The profession has earned for itself the character of being the most self-sacrificing of all professions, and they are as well in the front as leaders in promoting sanitary



science and the prevention of disease, as they have always been in the gratuitous relief of human suffering.

But professional rivalry does sometimes tell against the Health Acts. There is a very strong opinion that no medical officer of health should, while holding such an appointment, practice his profession in the ordinary way. There is, however, little doubt that taking medical men as a whole, they are among the best administrators of the Health Acts, and perhaps that is why they are so sparsely represented upon sanitary boards.

### Remarks of Medical Officers of Health.

1. "The men on the board say things will do when officers report the necessity for removal of nuisances."

2. "I believe if we had more supervision by the Local Government Board by occasional visits from one of their staff to see how work is carried on, and suggest a closer attention to some matters, the officers would be able to discharge their duties more efficiently."

3 "It is a great mistake for a second medical man to be on sanitary committee—they are only obstructive to any progress."

4. "The members are generally elected upon political grounds."

5. "As a cure for these evils, appointment by the Local Government Board of regular sanitarians, who shall make periodical tours of inspection through different townships. These men would be in an irresponsible position."

6. "I have much pleasure in filling up your schedule, as I consider your enquiry a very pertinent one."

7. "The tone of the Committee has been coming down for some years."

8. "I am glad some one is looking into this very important subject."

9. "The Medical Officer is only one voice amongst the many, and he is not a member and has no vote."

10. "The small salary does not compensate for the amount one loses by offending people while doing one's duty."

11. "No matter what reform one may introduce, unless it is palatable to the majority of the Board, who know nothing of the matter and are only influenced by trying to keep down the rates and remain in office, one can get nothing done."

12. "He frequently gets no end of abuse for ventilating such ideas (sanitary improvements). The consequence is the Medical Officer of Health either resigns or, finding it useless, no longer takes the interest he should in the matter, and so nothing is done."

13. "When a serious epidemic comes, the obstructionists are

the first to complain and wonder why such a state of things exists."

14. "The motto of this Board is '*Dolce far niente.*'"

15. "Speaking generally, sanitary boards are slow to move, but they do move, and perhaps as quickly as we could well expect."

16. "In consequence of being medical officer to large works cannot in this case use compulsion."

17. "The mayor and town council constitute the local authority, and they are selected and elected not for any sanitary reasons or fitness."

18. "River still in frightful mess. People generally uncivilized and board very representative."

Farmers appear on the returns in the proportion of $7\frac{3}{4}$ per cent. They are for the most part an independent class, but the surroundings of the farm yard and familiarity with the odours thereof, so grateful to the bucolic nose, and the advantages of an open air life, may perhaps lead to a want of appreciation in the mind of the husbandman of the necessities of those who live in thickly populated places where sanitary improvements are most needed. Four per cent. of them are property owners, that is $\frac{1}{8}$ per cent. less than builders.

Lawyers, of whom there are $3\frac{3}{4}$ per cent. upon these Boards, as men of education and administrative ability, are no doubt often useful members, but as representatives of trustees, mortgagees, and executors, they are largely interested in saving expenditure upon house property, and it is to be feared they are doubtful sanitarians. Speaking of a lawyer, a Medical Officer of Health says:—"He takes a very sensible view of things unless the interests of clients interfere." Another says a lawyer dominates the committee, and throws obstacles in the way of sanitation if expense is likely to be incurred.

Estate agents are represented to the amount of 2 per cent. They must be placed on the side of the goats, while auctioneers, who appear to the extent of about $1\frac{1}{2}$ per cent., must be regarded as questionable sheep.

There are only 33 engineers, or $1\frac{1}{4}$ per cent., and of these one Board has 7 out of 9 members; and the remark of the medical officer is, "This Board is one of the best in England."

The clergy number 23, or $\frac{3}{4}$ per cent.; it is difficult to say why there are not more of them, their presence in such a position could but be good; for as men of culture, and as visitors of the sick and poor, they can well understand the necessity for sanitary work.

There are $1\frac{1}{4}$ per cent. of architects, and the experience of some is that plans can be passed by members of this profession



when serving upon such Boards that are rejected when presented by outsiders.

There are 20 schoolmasters—5 under the head of army, 7 literary, 8 contractors, and 2 registrars of births and deaths.

As a rule, the professions or classes least likely to produce unobjectionable members of Boards of Health are much the most sparsely represented.

Of all men who are directly and selfishly interested in saving life, and who, it might be expected, would be found largely represented on Boards of Health, the insurance or life agents stand first. But, as a matter of fact, there are only 7 of them out of 2,796. Why, it almost suggests itself to one's mind that, considering their very great interest in the preservation of human life and the *enormous* numbers of "life agents" available, that the matter of the public health might be very safely placed entirely in their hands. But if it is astonishing that life agents are so few, what will be thought of the fact that the agents of grim death himself appear among those elected as members of Boards of Health. Men who absolutely live by death, whose business becomes more lively as the epidemic becomes more deadly. Men who would only be expected to be found serving as promoters of a Public Disease Act. Men whose regular occupation it is to carry us from our houses to our last homes feet foremost; who provide for us our "customary suits of solemn black," and whose crocodile tears are charged in the funeral bill. It is a horrible revelation, but of the 2,796 members of Sanitary Boards four of them are *undertakers*. It is thought the undertaker comes appropriately at the *end* of all professions.

From the returns made as to the number of property owners it was found that there were 408 members serving upon the 37 boards; of these 408 members, 251, or about 55 per cent., were property owners.

| | |
|---|---|
| The greatest number of property owners are found among the manufacturers, the proportion being ... ... ... | 16 per cent. |
| Next come gentlemen who are property owners in the proportion of ... ... | 13 „ |
| Shop-keepers are property owners to the extent of ... ... ... ... | 11 „ |
| Merchants to the extent of ... ... ... | 7 „ |
| Builders about ... ... ... ... | $4\frac{1}{8}$ „ |
| Farmers ... ... ... ... ... | 4 „ |

Or a total of 55 per cent. of property owners, upon the 37 boards of which returns were obtained.

This analysis shews that the three most numerous classes serving upon sanitary boards, are also by far the largest property owners, 40 per cent. of the total of 55 per cent. belonging to these three classes, namely, the shop-keepers, the manufacturers and the gentlemen. It is not for a moment suggested that all these owners of property are landlords of unsanitary dwellings. But there is surely some meaning in the fact that by far the greatest proportion of property owners, are to be found among the classes most numerously represented. There are hardly two opinions as to whether builders do or do not make good members of sanitary boards, but if similar motives to those of the builder actuate other men, then it looks bad for sanitary boards that they are made up of 55 per cent. of property owners. The speculative builder erects the unsanitary dwelling, but when he has sold it to the manufacturer, the gentleman, or the shop-keeper, are the owners of these same dwellings not just as likely to resist any attempts to make them sanitary as the builder would be if he had not sold them? And there are forty members of these classes who are property owners, to every four builders. No doubt property should be represented in some form upon sanitary boards, or perhaps there might be cases in which enthusiastic sanitarians would want whole towns rebuilt.

## Remarks of Medical Officers of Health.

1. "Mr. —— owns a large amount of house property of all sorts, and is slow to improve his own property and anxious to avoid expenditure on public works."
2. "In the cases where property owner is mentioned, the owning of property is almost as much a business of the person as his other trade, if he has one, and sometimes more so."
3. "9 out of 12 are property owners."
4. "All of them are, I believe, owners of property."
5. "In many cases all are property owners except one or two."
6. "One member owns a considerable quantity of property of a very inferior character, but still keeps it in fair sanitary condition."
7. "Of course owners of cottage property are well represented."
8. "I ceased to be Medical Officer of Health a year ago, resigning owing to a cabal of tenement property owners, on whose toes I had rather severely trodden."
9. "Those interested in property have it all their own way here, as no fewer than 14, all influential, are in the property business, and several other members rely on them for business."
10. "There is no doubt that the greatest opposition to sanitary progress comes from members of committees who are agents for or owners of defective cottage property."



11. "Two-thirds of the committee here are largely interested in cottage property, more or less defective, as agents or owners, and sometimes entirely depend upon it for their income from such property. One cannot wonder at the opposition and at the slowness of progress."
12. "The owners of property are well represented, and it is consequently difficult to get sanitary improvements carried out."
13. "Four out of nine members are owners of cottage property."
14. "Four out of six members are owners of property."

To recapitulate, the numbers of the different trades and professions are as follows:—

| | | Per-centage | | | Per-centage |
|---|---|---|---|---|---|
| Shop-keepers | 862 | 30·84 | Clergy | 23 | ·82 |
| Manufacturers | 489 | 17·49 | Schoolmasters | 20 | ·72 |
| Gentlemen | 327 | 11·70 | Artizans | 17 | ·61 |
| Merchants | 241 | 8·62 | Literary | 8 | 1·18 |
| Farmers | 216 | 7·73 | Insurance Agents | 7 | |
| Builders | 212 | 7·58 | Army | 5 | |
| Lawyers | 104 | 3·71 | Artists | 4 | |
| Doctors | 89 | 3·19 | Contractors | 3 | |
| Estate | 56 | 2·00 | Registrars | 2 | |
| Auctioneers | 42 | 1·50 | Undertakers | 4 | |
| Engineers | 33 | 1·18 | | | |
| Architects | 32 | 1·15 | Total | 2796 | 100·00 |

It is thought the conclusion to be drawn from this investigation is that deducting the members of the unobjectionable classes, numbering 452, or 16·16 per cent. of the total members, and consisting of merchants, doctors, engineers, clergy, schoolmasters, artizans, literary, insurance agents, army, artists, contractors, registrars, there remain 2344, or 83¾ per cent. of the number of those serving upon Boards of Health, who, *taken as members of classes*, and considering their interests and fitness, either present a negative attitude or active opposition to the administration of the Public Health Acts.

It will be remembered that 75 per cent. of the circulars sent out obtained no replies, but it is not thought that the absence of these replies indicates a better state of things at the places of which no returns were made than appears to exist at the 25 per cent. of Health Boards, the returns from which form the basis of this paper.

It is not suggested that virtue dwells in one class more than in any other. Selfishness, the great human imperfection, pervades all classes alike, and power which gives facilities for the

exercise of it, becomes one of the greatest tests of human character. In the existing government of the world jobbery is as rife when the power of an aristocracy is supreme as it is where the most advanced democracies hold sway. There is no doubt that all classes of men are apt more or less to use the power given them to further their self-interests; and it is thought there is sufficient evidence in this paper to show that the influence they possess is thus exercised by a large percentage of those who administer the Public Health Acts, to the serious injury of the usefulness of these beneficent laws, and that some steps should be taken to remove the evils indicated, and secure to the nation a much more rapid advance in its sanitary condition.

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[*This discussion applies to the two preceding papers by* Alderman J. S. Rowntree *and* T. Harnett Harrisson.]

Mr. H. H. Collins (District Surveyor of the City of London) expressed great regret that a paper, such as had been read, should have been published under the auspices of the Sanitary Institute. He questioned whether Mr. Harrisson had ever taken part in municipal government. No doubt that there were men, as in every public assembly, who occupied a position on local boards from not unselfish motives, but it was gratifying to find that members of every class were introduced to those bodies, who took an intelligent view of sanitary and other work. The "speculative builder" generally came in for a good deal of undeserved censure; but they should complain not of the speculative builder, but of the administrators of the law, who did not see that the laws regarding speculative building were efficiently carried out.

Mr. Washington Lyon (London) said the paper read by Mr. Rowntree was quite refreshing. It told them what the public ought to do, and it rested with the public to carry out what the paper suggested. All that was wrong within the Board was the fault of the people outside, who were the electors. He thought the other paper read by Mr. T. H. Harrisson, was a perfect burlesque upon local self-government, which, the speaker thought, was on the whole a credit to the country.

Mr. S. W. North (York), who said that hitherto he had never had anything to say at meetings of the Institute but what was agreeable and pleasant, strongly condemned Mr. Harrisson's paper as a libel upon the representative government and municipal authorities of this country. One point of satisfaction was that nearly 600 of the



medical officers declined to answer the impertinent questions that were put to them with respect to those in whose service they were. The Council, he said, should never have printed the paper, and he hoped they would redeem their position by expurgating it from the records to be hereafter published.

The Lord Mayor of York, after speaking in complimentary terms of Mr. Rowntree's paper, expressed his opinion that if the paper read by Mr. Harrisson appeared in the records of the Congress, it would do such an injury to the object of the Institute, as it would take years to repair. He was sorry to hear such a diatribe against the Corporations of this country.

Mr. Rogers Field (London) did not agree with the form in which Mr. Harrisson had put his paper, but could by no means give such scathing condemnation to it as had some members of the Congress. From his experience in London, he could strongly confirm Mr. Harrisson's statement that builders were often great enemies to sanitary progress, as they were the most determined opponents of anything they considered contrary to their interests. An instance of this was the way in which the builders on the London vestries opposed one of the greatest sanitary advances that had been made in modern times, viz., the enforcement of stringent regulations as to the details of the drainage and sanitary construction of houses. Such regulations, he said, were enforced in most large provincial towns, but they were exceedingly rare in London; and it was to a great extent the builders on the vestries who prevented such regulations being made and enforced.

Dr. Ewart (Brighton) supported the views of Alderman Rowntree as to the proper selection and the payment of corporation officers. As to the second paper he thought it should only be published with a certain amount of revision. The speaker defended the members and permanent officials of municipal bodies from the charges made by Mr. Harrisson, specially emphasising the high character and excellence of the officers of the Brighton Corporation, with which he had the honour of being associated.

Mr. Whitaker (Southampton), as one who had not been a member of the local board, nor was likely to be one, bore his testimony to the good work done by many local boards.

Mr. M. Ogle Tarbotton (Nottingham) agreed with the views of Mr. Rowntree, but strongly opposed the views of Mr. Harrisson, and stated that any speculative builder who endeavoured to scamp his work would be sure to be found out.

Major Flower (London) said he protested against the views expressed by Mr. Harrisson in what the speaker called an "unfortunate paper."

Mr. G. J. Symons, F.R.S. (London), considered it unfortunate that the two papers had been taken together, because the somewhat vigorous language employed by the author of the second paper had diverted a good deal of attention from the large amount of information conveyed in Alderman Rowntree's paper—a paper of the very highest quality, and one on which there could not be two opinions. As to Mr. Harrisson's paper, there was a great deal of truth in it; and with respect to the remarks which had been made about the Council receiving and printing it, he would remind the Congress that the Council were not to accept only such papers as they thoroughly approved of and agreed with—that would not be the English principle, which was for free and open discussion. It would be utterly childish to refuse all papers except those with which everyone would agree. The Council was not responsible for the opinions expressed in the papers, and it was so stated in every volume of the Transactions. As to Mr. Harrisson's statements, it was well known that the facts stated were in many cases true. Moreover, they were *not* Mr. Harrisson's statements but those of his correspondents. He would not traverse all the remarks which had been made, but would merely state that the present filthy condition of our rivers was not due to the absence of legislation, but to its not being put in force, and it was not put in force because the offenders were also frequently those whose duty it was to commence proceedings against themselves.

Mr. W. R. Maguire (Dublin) said that as he was not a Medical Officer of Health nor a Member of the Council of the Sanitary Institute, he begged leave to differ from the opinions expressed by the preceding speakers on Mr. Harrisson's paper. We have all heard from time to time the complaints made by Medical Officers of Health of the very grievances which this valuable paper perhaps somewhat bitterly places on record. As a business man it seemed to him that the soreness and angry feeling evoked by the paper was caused by the unpalatable truth of the statements, and he hoped that the Sanitary Institute would publish this paper in their proceedings. Great trouble was evidently incurred in collecting materials and putting them together; evidently no reward was sought for or expected by the writer except the public good, and he (Mr. Maguire) thought that the paper had been very shabbily received.

Mr. Hanson (London) stated that, as Mr. Harrisson had said, the "Jerry builders" influenced the local elections in London in their own interest.

Mr. Alderman Rowntree (York), in a brief reply, said he believed that if medical officers of health presented their views to their boards and the public again and again, quietly, and in an educational way, they would in most cases ultimately obtain what they desired.

Mr. Harrisson (Liverpool) replied, and said his paper was suggested by papers formerly read at that Congress. His information had been obtained from medical officers of health, and he believed that his paper was correct in its statements and conclusions. The language of abuse, as it had been termed, was not his, but that of the medical officers.



The Chairman, Mr. Baldwin Latham, said Mr. Rowntree's paper was extremely interesting, and was put before them in such an instructive manner that he (the Chairman) could not add anything to its value. It was curious how Mr. Rowntree had linked the old with the modern period, and it was to be remarked that if the people now lived as our ancestors lived, the death-rate would exceed the birth-rate. They were indebted to Mr. Rowntree for the trouble he had taken in the matter. As to Mr. Harrisson's paper, it was no reflection on the inhabitants of a town that their local governing board was formed of a majority of tradesmen. He must, however, say that there was a substratum of truth in that paper as to the overriding of medical officers of health's proposals, and he spoke from large experience of such bodies. He knew that three of the ablest medical officers who ever held office in this country, who had given up their own profession to follow that of medical officer, had been driven out of office by authorities because these officers had done their duty. In conclusion he proposed a vote of thanks to Mr. Alderman Rowntree and Mr. Harrisson. The vote was carried *nem. con.*

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## *On "The Sanitation of our Dwellings," by* J. Vickers Edwards, County Surveyor (West Riding, Yorkshire).

The subject of this paper is, I am afraid, of such vast dimensions and importance, that it will be impossible for me to deal with it except in a general sense; hence I do not propose to go into matters of construction or engineering details. You can obtain that from the number of good books which have from time to time been written dealing with this question, and by entering into detail I should only be troubling you with matter that you can read in your quiet leisure.

That Sanitary Science has made rapid strides no one, I think, will be so bold as to contradict; for instance, what was the difference between the condition of London prior to the Great Fire and that of the present day? There then existed a network of narrow, dark, and tortuous lanes, the houses mostly built of wood and lofty, and each storey hanging over the one below, so as almost to meet

at the top, with large signboards extending half-way across the streets, all no doubt very quaint and charming in outline, but very obstructive to light and air. The sewers were ill constructed and totally neglected, and the sewage was allowed to flow in any channel it could, and in any way, so that it was got rid of,—that was the one thing desired. With the Fire came the first effort to promulgate certain useful and necessary regulations. The streets were widened, provision was made for the better drainage of surface-water, cesspools were formed for the prevention of choking the sewers with sand or gravel from the roadways, and regulations made for the cleaning of the public thoroughfares. From this period we have gradually gone on improving, and from the decreased death-rates it will not be denied that Sanitary Science has done something to lengthen the lives and add a little of happiness and comfort to our fellow-creatures. But there still remains a vast amount of work to be done. Local prejudice and self-interest have to be broken down, and the people gradually educated as to what is best for their welfare. Parents must be taught, that unless they have healthy, clean, sanitary homes there is nothing but a series of domestic troubles in store for them.

Dr. Richardson admirably gives seven points as an outline of general domestic sanitation, and they are as follows:—

"The healthy house must present no facilities for holding dust, or the poisonous particles of disease; if it retains one it is likely to retain the other.

"It must possess every facility for the removal of its impurities as fast as they are produced.

"It must be free from damp.

"It must be filled with daylight from all points that can be charged with light from sun without glare.

"It must be charged with perfectly pure air in steady changing current.

"It must be maintained at an even temperature, and must be free from draught.

"It must be charged with a sufficient supply of pure and perfectly filtered water.

"A house possessing the advantages named under these heads cannot be far from a perfectly healthy house. It is a house in which disease will never be generated so long as it is kept up to its proper standard. It is a house in which disease, if it be introduced, will remain for the briefest possible period. It is a house which, after disease has left it, will admit of instant and complete purification."

And in order to obtain these happy results, how is the work to be started? This is a very difficult problem. All localities



are not the same, one person thinks this way and another person thinks another, and I have no doubt that many of our sanitary engineers and sanitarians will be quite prepared to tell you of the enormous difficulties they experience with local authorities in getting a plan of any well conceived scheme of drainage approved of. Some municipal surveyor or local surveyor will say I could not possibly recommend my corporation or local board to approve of your plans. Your pipes are far too small, we cannot allow you to cut off your drainage from our main by your so-called intercepting trap, and you must place Buchan or other approved traps at the base of your soil pipes and generally ventilate your town sewers through your drains. I am not at all exaggerating this state of affairs, for on more than one occasion has this condition of things been tried to be imposed on me.

No, it is not by the action of these local authorities that sanitary science will progress, and it is not by a forced scheme of legislature that we shall be successful. The masses must be educated to act for themselves, and sanitary officers appointed who can lay claim by qualification to such an important office, and men who will act fearlessly, impartially, and with but one object in view, the health of their fellow men.

True it may be said there are such men appointed by the local authorities whose duty it is to report upon and take steps to abate nuisances and other matter prejudicial to health, but to what extent is that carried out and how can a man work against influence, and, generally speaking, what is the education scientifically of these men? I know, in my own town, the sanitary officer was asked, Have you had many complaints as to the smoke emitted from manufacturers' chimneys? Oh, yes, a great many, was the answer. What steps then have you taken to draw the attention of the manufacturers to their breaking the law? I have laid the complaints before the Sanitary Committee, and their answer was, You must not take any notice of these complaints, we wish there were more large chimneys in the town. However, I was not content with their answers. Single-handed I attacked the largest manufacturer in the town, and obtained a conviction in the Local Court of Justice, and in face, too, of an interested Bench. I merely give you this example to show that private individuals should not have to bear the brunt of the fray themselves, but that sanitary authorities should be compelled to do their duties.

Take yet another example, the rivers of the county. Instead of being carriers of pure fresh water giving happiness and joy to all in our manufacturing and closely-inhabited districts, they are simply carriers of sewage and filth, and yet these local sanitary authorities are armed with sufficient power to prevent

or certainly to ameliorate this condition of things; but no, self-interest steps in and says we must be neutral and not hurt our manufacturing neighbours.

In support of my theory that sanitary officers should be qualified men, having gained a diploma and certificate from the Sanitary Institute, and that no local authority should employ such an officer unless he held such a diploma, I will give another example. Take our large watering places—Scarborough, Blackpool, Eastbourne, Brighton, &c.,—where the major part of the population at certain periods of the year is ever changing, many of the lodging houses have obtained certificates of a clean bill of health as to the sanitary requirements of their houses. Well, at Scarborough and other places I know from experience you will find nine-tenths of the houses fitted up with old abominable pan closets, insufficiently flushed, soil pipes inside the buildings, a few may be ventilated, but the major part not, and when the soil pipe is ventilated what does it consist of? a two-in. rain water pipe carried from the trap up to above the roof with open joints, and crowned at the outlet with some wonderful head gear in the shape of a ventilating cowl; all this work doing more harm than good, and yet these houses are all certified, and the British public think they are quite safe. So much for the value of these certificates.

I hope I shall not be wounding the feelings or susceptibilities of our leading architects when I say that the scientific knowledge of drainage and sanitary plumbing is not sufficiently paid attention to by them; often, indeed, lines of drainage are indicated on a plan and left to be worked out by the clerk of works and builder. For a few years all may be well, but, depend upon it, the day of reckoning must come. What happens? A system of patching and botching up is done, and this makes the state of things worse than the first. I am sorry to say, in my short experience, I have met with lamentable cases of this kind. What I say to our architects is this, if drainage, water supply, and sanitary science be beyond the sphere of your calling, do not hesitate at once to call in some experienced sanitary engineer, who will guide you safely through, or, take the middle course, and have your opinions approved of by some such man: if you needs must err, err in good society. Speaking for myself, having had recently to carry out drainage and sanitary work to the value of £40,000, I called in a well-known sanitary engineer to aid and assist me with his experience; and I have no hesitation in saying success will be achieved where it might have been doubtful, and then, what a comfort and ease to your mind is the fact that you have your opinion endorsed by a competent authority.



That the general public are somewhat prone to under-estimate the value of carrying out drainage in a perfect and systematic manner is, I am afraid, not to be denied. Some of my clients have repeatedly said, "Could we not dispense with this costly system of inspection chamber, with its glazed brick sides and glazed stoneware inverts, and your Stanford jointed pipes?" "Oh yes," my reply was; "you can do without these things if you like." The case stands thus: With a system of drainage of straight lines, and inspection chambers and manholes, every part of the system is accessible for inspection and cleaning. If you simply bury your pipes, however truly laid, without such, in case of stoppage you have constantly to be breaking open the surface. And which is the cheaper and better in the long run? To have a perfect scheme open at any point for examination, or breaking up the surface and disruption? No, depend upon it, care and regularity, and a thoroughly practical scheme, will pay the best in the end. And before closing my remarks upon drainage, I would impress the fact very strongly—never allow a builder to do anything with your sanitary arrangements; if you require advice, go to some competent authority. The amount of money expended by people in employing incompetent persons is something enormous, and I regret to say it is almost a daily occurrence.

Houses are bought without even a thought about their sanitary arrangements, then when something is required to be done, a builder, or some so-called sanitary engineer, who examines the house for a small fee, and recommends here a trap, there a trap, and everywhere a trap, is called in. The result of all this is, some recognised engineer is called in, who is horrified at the state of things, and the pruning knife has to be most unsparingly used. I assure you this is no uncommon occurrence; and to what does all this lead? The masses, as I said before, must be educated; it behoves every intending tenant or purchaser to make the most searching examination he can of the house he proposes to buy or inhabit. He must insist upon stipulations in the agreements, and protect himself by taking competent advice as to the structural and sanitary condition of the house to be leased or bought. Here again comes the importance of proper and vigilant supervision on the part of the local authorities over the construction of houses, and this is particularly needed for those dwellings of the poor and uneducated classes.

It was only the other day I was called in to give some advice as to the house to be occupied by a client of mine. Well, I examined it thoroughly. In the course of such inspection I found the soil pipe a $3\frac{1}{2}$ in. rain water pipe brought down the

inside of the house, connected to a 6 in. earthenware bend. At the joint it was open, being flagged over at the basement level; where the flag had been cut round the pipe, there was a hole ¾ in. wide, the soil pipe was carried up to the trap of water-closet (a wash-out type), and then terminated. Below the trap of this closet the lavatory waste and bath wastes communicated. The 6 in. exterior main communicated direct with the main sewer in the street. I told my client he was living in a house which was ventilating the town sewers, and further said to him what should be done. "Ah! well," says he, "I will do something; other people have lived in the house without ill-effects, and you are really such an expensive man. Can you not recommend some middle course." "No; you must do the thing properly or not at all. Remember, you have my opinion in writing, if anything occurs do not blame me." The result was, someone was employed to do something. I declined to act further, and I have no doubt my friend thinks he is quite safe. This, I am sorry to say, is one of the many cases a sanitary engineer meets with, and it is often a difficult task how to act; but depend upon it, the man who unswervingly sticks to his post and has the courage of his own convictions will in the long run succeed.

It will be seen that the preceding remarks have dealt in a general sense with exterior matters, I wish now to say a few words upon interior fittings and appointments. These should be of the simplest and plainest character, easy of access, no corner or crevice where dirt can possibly accumulate, and everything exposed, so that the eye can take all in at a glance; never bury pipes in a wall or cut a chase for them, whether they be hot or cold water mains, supply pipes or gas pipes, everything should be visible. At two asylums of which I am the surveyor the water main and steam pipes were so placed in the walls, and they have proved such a continual source of annoyance, by reason of their being simply rat runs, that I am now taking all the pipes out, placing them on the face of the wall. It may be argued they will appear unsightly, but better be it so than have a continual annoyance and trouble from vermin; besides, too, how can you get to repair a leaking joint when so encased. As to the effect of gas from a leaking pipe no one can estimate the damage upon the human frame from the effects of poisoning by escape of coal gas. I believe it is more deadly than sewage gas; slower, but surer, and more efficacious in its work.

Before closing this paper I would like to say a few words as to the general use of materials internally in buildings.

I think the walls of all kitchens and scullerics should be lined



with ivory white, glazed brick, or tiles, up to a height of 6 feet from the floor line. This would prevent splashing or dirt, and would be easily cleaned. The floors, too, might be laid with concrete floors of broken marble and cement, worked up to a very fine surface: such a floor is very readily kept clean.

The floors of a building should be laid, where wood is used, with oak boards; but if expense has to be thought of, then pitch pine boards, 3½ in. wide, tongued and grooved, and secretly nailed, make an excellent hard floor, which lasts very well.

I have seen many floors laid with yellow deal, where washing is a constant practice, rapidly going to decay after a few years use.

Floors of either pitch pine or oak, are capable of being highly polished, and the carpet need not cover the whole surface; this is most desirable, as it allows the carpet being taken up oftener than it would be done if it covered the whole surface and was secured to the floor.

All fire grates should be constructed so as to entirely consume their own products. There are many such grates to be obtained, and it is, indeed, difficult to say which is the most desirable. By experience I have found any grate with fire clay sides that retains a heated chamber under the grate effectually cutting off the cold air of the room, will effectually burn coal to complete ash. Mr. Pridgin Teale, of Leeds, has paid some considerable attention to this subject, and he claims for this heated chamber —1st, saving of fuel; 2nd, more uniform heat; 3rd, the longer keeping in of the fire without watching; 4th, diminished soot and fewer ashes to remove.

As to ventilation and the different methods of heating, time would not allow me to go into this question. Simply let me say, although perhaps seeming a difficult subject, a little care and trouble will soon unravel all its mysteries. Let your inlets of cold air be always under control, and your outlets for vitiated air sufficiently numerous and the extractor powerful enough to do its work. As to the number of pneumatic extractors daily placed before our notice, I would not be so rash as to pronounce judgment on any one, although many have been used by me, but speaking for myself I would rely more for extraction of foul air upon heat, or where it is possible use a fan.

In concluding this paper I would especially draw attention to the important part furniture generally bears upon the sanitary dwelling. Let your fittings and appointments be of the simplest kind. Avoid excess of curtains; if they must be used, let them hang down in straight, natural folds from a brass rod, and not be draped or looped up as to form lodgment spaces for dust. All fringes and valances should be avoided for the same reason,

as well as from the fact that they are utterly inartistic. In a dining room they naturally absorb and retain the smell of food, and tend to make the room stuffy and unhealthy, and for the same reason they should be avoided in sleeping rooms.

Furniture itself should be so constructed as not to be heavy and bulky, but easily removed; if it is not, the floor space underneath will become covered with dirt; if it is necessary to have heavy furniture, arrange it so that you can sweep and clean underneath it. Do not rush with eager haste to furnish your house; take time, and let each piece answer the purpose for which it was originally designed.

Avoid an excessive display of gasaliers. If you must need have them, let them be plain and simple, of bronzed brass, and not lacquered; gas tends to destroy everything in our rooms, and to render them hot and stuffy and unhealthy. Avoid all papers for walls which hold dirt and are absorbent, and by all means let them be non-arsenical. Our continental brethren, by legislation, years ago, prohibited the sale of such materials, but we are too sacred a race for such radical edicts. Lastly, clean out as often as possible every room and every cupboard in your house; give away anything that is fit to give away, which may no longer be required by yourselves, and burn or destroy all other litter and lumber, which only affords resting-places for dirt and dust and living impurities which grow out of dirt and dust.

[*For discussion on this paper see page* 246.]

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*On "The Ventilation of Factories and Workshops," by* WILLIAM TATTERSALL.

THE efficient ventilation of Factories and Workshops is, it seems to me, a very important branch of practical sanitation, and as I cannot find that it has been dealt with previously, I venture to put before you some considerations and suggestions which are the results of my experience in this particular line of Sanitary work. As the chief trades carried on in factories are the textile trades, it may be interesting to know that, according to the census return for 1881, the number of persons engaged in those trades in England and Wales was over a million; of whom 530,000 were engaged in the cotton trade, and 233,000 in the woollen and worsted manufacture; the remainder being engaged in the manufacture of hosiery, silk, lace, linen, carpets, hemp,



&c. In the cotton manufacture, the proportions of the sexes employed was 164 females to every 100 males; in the woollen cloth manufacture there were 102 females to 100 males; and in the worsted and stuff manufacture 180 females to 100 males; in the silk and ribbon manufacture the proportion of females was still greater, as there were 224 to 100 males. As there is no doubt that a considerable proportion of factory operatives are young persons, the importance of efficient ventilation is further emphasised, and is generally admitted by everyone, in theory. But judging by the state of many factories and workshops, its importance is very slight, in practice; and the following extract from the last report of the Chief Inspector of Factories and Workshops is interesting in this connection. He says:—"The injury inflicted by an unfenced piece of mechanism cannot be hidden, and enquiry as to its cause leads to a recommendation which would prevent accidents in future. But the evils which follow constant employment in overcrowded and ill-ventilated workrooms, are insidious in their inception, rarely complained of openly by the sufferers, and do not in their effects appeal so readily to the sympathy of employers, as do the injuries to the person caused by machinery. It becomes thus a more difficult matter for us to deal with overcrowding and want of ventilation."

The particularly unhealthy conditions under which the textile trades are carried on, are commented upon as follows, in the supplement to the last annual report of the Registrar-General. He says:—"Among the textile industries there are two in which the death-rates are high, and unfortunately these are the two in which by far the largest number of persons are engaged, viz:—the cotton industry of Lancashire, and the woollen and worsted industries of the West Riding. The comparative mortality figures in these industries are 1088 and 1032* respectively. It can scarcely be doubted that the main cause of the differences is to be found in the conditions under which the industries are severally carried on, and especially in the differences that they present in regard to the dustiness and the temperature of their respective working-places. In the cotton factories the temperature of the weaving sheds is described in a recent (October 1883) report by Dr. Bridges to the Home Secretary, as "tropical and relaxing;" and dust, composed partly of filamentous particles of cotton and partly of mineral substances used for sizing, is stated to be a notable feature in most of the sheds." It will be found also on examining the tables, that the death rates from diseases of the respiratory organs are very high in the Lancashire and West Riding towns, where the textile trades

* See Supplement to the 45th Annual Report of the Registrar-General, page 24.

are mainly carried on; as the following extract from the supplement previously mentioned also indicates; writing of the effect of dust on the respiratory organs, the Registrar-General remarks: —"More injurious than either coal-dust, wood-dust, or the dust of flour, appear to be the filaments and fluff and other dusts that are given off in textile factories; the mortality both from phthisis and from diseases of the respiratory organs being higher among workers in cotton and in wool than among persons exposed to either of the previously mentioned kinds of dust. The workers in cotton factories fare worse than those in wool, the comparative mortality from the diseases in question being, 543 for the former and 462 for the latter. It must be remembered, however, that the air in the weaving sheds of cotton factories contains not only flocculent matter, but also a large amount of dust from mineral substances of various kinds used in sizing, and that the inhalation of mineral substances, judging from industries presently to be considered, is much more injurious than the inhalation of textile filaments. The deleterious effects of dust upon the air-passages is increased both in the cotton and in the wool factories, and especially in the former, by the high temperature in which the work is carried on, and it is impossible to say how much of the lung mortality is due to the latter cause, and how much to the dust.

So much then for the considerations as to the need of ventilation in Factories, and I take it that if they had been more efficiently ventilated than appears to have been the case when the foregoing observations were made, and which by my own observations is the case now in most factories, the presence of polluting matters would not have been so evident, as they would have been got rid of as fast as produced, and so the evils resulting from their presence would have been much less.

I pass on now to a consideration of the means by which these evils can be lessened by an efficient system of ventilation, and in doing so I propose to consider the main sources of impurities separately, and in each case the production, amount, effect and removal of such pollution. The main sources of impurity in factories I have found to be as follows: and I say nothing further of the impurity arising from, or given off by the workpeople themselves, as that is seldom or never the only or main source, and is merged into the greater, both in effect and removal. The principal impurities are *dust*, *fumes*, *excess of moisture*, and *heat*. Objection may be taken to *moisture* and *heat* being considered as impurities, but in excess their effects are probably as ill as those of the actual impurities, and therefore they need removal.

In many cases *several* of these impurities are present together,



aggravate the nuisance, and often make its removal more difficult. *Dust* I have found to be the greatest impurity, and to be present, more or less, in almost all the processes through which textile fabrics pass in manufacture, and often where the stuff is made into clothing.

The rooms where the carding, combing, winding, spinning, &c., of cotton, woollen, worsted and other textiles is carried on, all have their air rendered impure by the dust and particles of fibre given off from the material in course of manufacture, and in addition the sheds in which *cotton goods* are woven, and especially with certain classes of goods, the solid particles of the size with which the yarn has been treated becomes loose, and in addition to particles of cotton, float about in the air of the shed in considerable quantities; and to prevent this result, and because more work can be got off in a certain time with a moist atmosphere, an apparatus known as a Humidifier is used: by means of which, saturated air at a high temperature is forced into the shed, keeping the air inside *hot* and *moist*, and to prevent radiation of heat and condensation of the moisture, all apertures that *might* admit fresh cool air, are carefully stopped up, including both inlets and outlets for ordinary ventilation, if any have been provided, which in many cases they have not; some employers simply blow steam into the sheds during meal times, and trust to that for keeping the place moist enough for their purpose during the rest of the day. As artificial moisture is most needed during *frost*, the effect of passing from the warm moist air of the weaving shed to the cold frosty air outside, must be very injurious, as may be imagined.

A report on this subject was, I believe, made some years ago by Factory Inspector Osborne, in which he came to the conclusion, that by using proper ingredients in the preparation of *the size*, there would be no need to introduce moisture into the sheds; and as the principal object of heavy sizing is, I presume, to give a fictitious weight and value to the cloth, not much sympathy would, I think, be extended to manufacturers if they were forced to discontinue such an unhealthy system.

In the weaving sheds of other textile trades, as *Woollen*, *Silk*, *Worsted*, and *Flax*, the impurities consist of dust and fine loose particles of whatever material may be worked there; with, in Winter, during a considerable part of the day, the impurities from a great number of gas lights, and in Summer great heat from the sun shining upon the glass roofs, and in some cases always, and especially in hot weather, the foul smell from closets and urinals adjoining the sheds, and not properly ventilated or constructed, or not regularly emptied.

*Carding Rooms*, at particular times, when what is called

grinding the cards is taking place, and the preparing rooms for silk, are extremely dusty. The breaking-up rooms also for other materials, such as Waste, Shoddy, and Rags for Paper Makers, and Esparto grass cleaning, and the rooms where these materials and Wool are sorted into different grades or qualities, are often so full of dust that the workpeople, who are mostly women and girls, have to wear a bandage over the mouth and nostrils to enable them to work at all. In many of the workrooms enumerated above, there is great excess of heat, and in some very foul smell arising from the material; the worst in this respect being probably silk-waste preparing rooms, in some of which the stench is frightful to a stranger, though it is said that the workpeople become used to and do not perceive it after a while. In many workrooms also, other than textile, there is a large amount of floating dust to contend with, as in all dry grinding processes where metal is ground on revolving discs, examples of which are: the glazing of metal faces in machine shops on emery discs, and the pointing of pins for textile machinery, in which processes large quantities of minute particles of metal and stone are set free and float about in the air.

*Excessive Heat.*—There are many workrooms in which this is experienced. The machine rooms in calico printing works, some of which in summer get as high as 130° F. The machine rooms also in paper mills, and the rooms in which *fine yarns*, both cotton, woollen, and silk, are gassed, or run through flames produced from a mixture of coal-gas and air, to finish them smooth. These rooms are the foullest that in a considerable experience I have come across, and this is not to be wondered at when we know that some thousands of gas jets are burning, and the whole of the fine particles that have been singed off the thread are floating about in the room, and produce an intolerable, irritating effect on the throat, nose, and eyes of strangers; and I have often seen the women and girls forced to go outside, and stay out a considerable time, to recover from the effects of working in such an atmosphere. The finishing, singeing, dyeing, and pressing rooms for textiles have usually a very high temperature. The rooms in which wool is washed, and cotton and woollen yarns are sized and dried, and the drying rooms for wool, yarn, cloth, &c., are among the worst, and especially as the excessive heat is accompanied with excess of moisture. I have known many rooms of this kind to have temperatures from 150° to 200°, with the air so full of moisture that a fall of 20° would produce saturation.

The combing and spinning rooms are kept above normal temperature and artificially moistened, but it is said this is necessary to produce good work.



In other than textile factories, the ironing rooms of steam laundries, and the making up and pressing rooms of wholesale clothing factories, in which much gas is burnt to heat the irons, are examples of workrooms in which the temperature is excessive, and the air foul.

*Steam or excess of moisture*, as an impurity, has already been mentioned several times, besides which instances it is found in excess mostly in dyehouses, where it is often produced in such immense volumes, and so continuously as to be quite beyond the power of any appliance to remove at a reasonable expense. In cold and foggy weather the moisture becomes most visible, as the point of saturation is sooner reached, and dyehouses become filled with thick fog for days together, so that nothing can be distinguished at a few feet distant. As dyehouses are generally of open and lofty construction, and there is no excessive heat, the health of the workmen does not appear to suffer much from their constant work among steam, and one hale old fellow of 75 to whom I spoke seemed to think it beneficial.

The construction of factories or rooms will govern the application of any system of ventilation to them. The ordinary method of ventilating weaving and other sheds has, I think, usually been inefficient by reason of the contrivances for exhausting the foul air being inadequate at their best, and uncertain in action when most needed, and also because the inlets for fresh air were not under control as to the quantity, temperature, or direction of the air admitted.

*The exhaust* has usually been by means of automatic ventilators of various kinds plentifully sprinkled about in the roof, and without in many cases any particular provision for inlets, or with simply holes in the walls which allowed the air to enter in gusts, and ensured the holes being speedily closed or stopped up with rags or anything else convenient. The lobster back cowl, and other wind-driven ventilators, are liable to get stuck and act as inlets, besides which in hot weather, when most needed, there would very likely be no wind to cause them to act. This last remark applies also to induced current ventilators, besides which none of those mentioned produce, at the best of times, sufficient movement of air to carry away the particles of floating dust, so that for this purpose an appliance is needed which will move air in large volume constantly, and be under control, as to the quantity moved; this is found in a type of exhaust fan, dealing with large volumes of air at low pressure, and requiring small power to drive, and which, placed near the centre of a shed, will exhaust air in proportion to the speed at which it is driven, and may be regulated to suit the temperature and other requirements, or amount of impurities

existing. We thus get a current of fresh air traversing the shed from all sides to the centre, and there being *constantly* discharged, irrespective of wind or weather. In some large sheds, several may be necessary, and in one very large one, I put four fans, having an aggregate displacement of 120,000 cubic feet of air per minute, or 7,200,000 cubic feet per hour, which changed the contents about 8 times per hour.

The best results have been achieved by placing one or more exhaust ventilators near centre of shed roof, and arranging the inlets at regular distances around the walls. The amount of air to be passed through will depend on the temperature and rate of pollution inside, and the inlets may, if needed, be carried down from roof, and the entering air warmed, cooled, or moistened at pleasure; there are plenty of appliances to be had by which air can be admitted without draught. A series of rooms, one above the other, may, if not too large, be dealt with by one exhaust ventilator, placed at the top of a vertical shaft, extending through the several stories and with outlets from each room, the inlets for fresh air to each room being so arranged that the air may, in its course from inlet to outlet, traverse the room, and especially that part in which the greatest source of pollution exists.

It is obvious that a series of small rooms on the same floor level may be dealt with in a similar way, by a horizontal air duct with openings to each room, and inlets as suggested above. In storied buildings in which the rooms are too large to be dealt with in this manner, each room may be treated separately, and many large workrooms are so treated, by having one or more exhaust fans placed on one side of the room, and fixed either to discharge through windows or openings specially made. The inlets in this case would be arranged on the opposite side of room to the fan, and possibly at the ends, if required, so as to cause the current of air to traverse the sources of pollution, whether dust, heat, fumes, or steam. Generally, the requisite effect in removal of polluting matters is obtained by running the fans entirely free from any kind of tubes on feed or room side; and where possible this is best, as less power is needed to drive them, and more air is moved when the area of feed is unrestricted. There are, however, some cases in which it is necessary, and many in which it is advisable, to carry away polluting matters immediately they are set free, so as to prevent their distribution in the atmosphere. In these cases it becomes necessary to construct tubes with openings near the source of pollution, and connected at the other or exit end with a fan, which when working produces a powerful exhaust, and carries away the polluting matter as fast as it is



produced. This arrangement may be, and is, applied with perfect success to remove dust, heat, steam, and fumes of various kinds. The tubes may be carried overhead, underneath, or level with the sources of pollution, and the impurities carried away may be dealt with in a chamber, so as to retain them and allow the air to escape pure. A good type of this arrangement has been largely carried out for the prevention of what is called "Woolsorters' disease." The men who sort the wool work at continuous tables, which usually are fixed along the sides of large rooms, close to the walls, and at which each sorter works opposite a window, on account of the light. In sorting the wool the sorter takes a portion from a heap placed on the table near him, and shakes it to loosen and open it out, so that he may judge of the quality, colour, &c.; and it is at this point that the greatest danger of infection occurs, as the shaking sets free the dust, short fibres, and other light matters, amongst which may be the bacillus, or germ of infection. To prevent, or at any rate lessen, the risk of infection, there is made opposite each sorter an opening in the table, to which is fixed a short downcast tube, which is connected with a larger horizontal tube beneath the table, at the extremity of which is working a fan, producing a powerful exhaust current in the system of tubes, and carrying away the dust set free by the sorters shaking the wool, which they do over the open ends of the small tubes.

In opening the bales of wool, also, a similar arrangement is used, but on a much larger scale, as the quantity to be dealt with is very much greater. In both cases there are wire gratings above the tables to keep the wool out of the tubes and allow the solid, but not floating matters to fall on the table for collection. This dust is most successfully dealt with by being blown into a settling chamber, in which a series of steam jets meet and damp it, so that it is deposited, and can be collected and burnt periodically.

I may mention, amongst other applications of this system, the removal of dust from silk dressing machinery, in which the main air ducts are carried overhead, with small vertical dependent tubes, terminating in hoods which cover the area of dust-production, confining it and facilitating its removal.

The fine dust produced by dry grinding processes, in which metal is ground against rapidly revolving discs of emery or stone, is also removed by a similar arrangement, in which the main tubes are about level with the grindstones and have openings opposite each stone, in such positions as to catch the dust as it is driven off and carry it away at once.

It will occur to anyone acquainted with work in factories that this system of extraction along tubes may be applied with

great advantage in many cases not specified in this paper. This is so; but to avoid error I have mentioned only such as I have designed and seen carried out, and are now in operation; and not all of these by any means.

In the construction of the air ducts the following points need attention, and the suggestions I offer are the results of, and have been verified by, experience.

The best material for tubes is galvanized sheet iron of a gauge proportionate to the diameter of the tube; it is light and strong, and is easily made into tubes of a circular section, which are smooth inside, and reduce friction to a minimum.

Wood is the other material available for tubes, and the objections to its use are, that it cannot be formed into a circular section, is liable to warp, twist, and crack, and causes greater friction of the air, and consequent loss of power. Its advantage is that it is cheaper (about one-third) than galvanized iron for tubes of same area.

In forming ducts inside walls or underground the best materials are: for large air ducts glazed bricks set in cement, or for smaller ducts glazed and socketted earthenware pipes jointed in cement. Bends, and especially right angled ones, should be avoided as much as possible, and where unavoidable should be curved to a large radius, or the tubes enlarged to reduce friction; inspection holes should be provided near bends. Branch tubes should be connected to main tubes by being curved in the direction in which the current of air is travelling, and I have got the best results by bringing small tubes, such as those connected to the woolsorters' tables, into the main tube at an angle of about 45° and enlarging them at the junction.

The openings near the fan should not be made too large, so that those further away may get their due proportion of draught; if this is not done, the fan draws its supply of air from the nearest openings, and the further ones are of no use.

No particular rules can be laid down to work to in proportioning the sizes of openings according to their distance from the fan, as much depends on the sizes, material, section, number of bends, and length of main tube, but a safe plan is to have each opening provided with a slide, so that they can be adjusted to give equal draughts, and then fixed to prevent tampering with by workpeople, who very often imagine, if they see an open tube, that they feel a draught, and would rather in many cases stand the chance of infection than have the temperature of the room lowered by a good system of ventilation, without heating. In one case I know, the woolsorters employed by a large firm petitioned that the system of ventilation described above might not be applied to their tables until the rooms had been heated



by steam pipes, which it took several months to do, and during which time they were working in a constant atmosphere of fine dust. In many other cases I have known workpeople stuff up every opening, and even paste paper over every crack or crevice that might admit fresh air. This sensitiveness is no doubt largely due to the quiet, still nature of their work, which requires very little moving about or exercise, and causes them to feel the smallest movement of the air. At the same time there are many workpeople who are very careless of the way in which they expose themselves or others to insanitary conditions, and will take their food without washing their hands, or removing their working smocks, and even take their meals seated on the work benches or tables, and amongst the unhealthy matters they may have been manipulating, and this in spite of the fact that special facilities have been afforded them in the shape of washing and dining rooms. Though many of the operatives are no doubt very careless and ignorant as regards sanitation, still there are some who appreciate its benefits, and credit is due to those amongst the woolsorters who agitated for compulsory bye-laws, to compel the best known means to be taken for the prevention of the mysterious and fatal disease to which they are subject, which agitation resulted in a series of regulations being drawn up, and agreed to by the Local Authority, Employers, and Operatives, which, though not compulsory, are generally carried out, and must contribute very greatly to the general health and comfort of the workpeople.

*Employers* are not always willing to take the necessary steps and spend the money necessary to ensure even moderately healthy conditions in their workrooms, where there is not a direct and perceptible result in better work turned out, or more of it. This disinclination is to be traced in many cases to the fact that they have already spent considerable money in that direction without getting adequate results, and so become doubtful of any good result following further expenditure, though no doubt the feeling of some employers on the matter is similar to that of one who asked the cost of ventilating a room, in which the operatives complained of being nearly roasted, and on being told the cost, which was evidently much larger than he imagined it would be, he simply remarked, "Let 'em roast, then."

In conclusion, looking at the important bearing that the efficient ventilation of factories and workshops, not only in the cases mentioned but also in very many others, has upon the public health, it seems to me that there should be some authority with power to compel the best known (or at any rate a satisfactory) means of ventilation to be carried out in what may

be termed unhealthy trades; what that authority should be, or the circumstances under which it should act, I do not pretend to suggest; but think that the Council of the Sanitary Institute might profitably consider the matter, and prepare a recommendation on the subject.

The exhaust ventilator mentioned in this paper is that known as the Blackman Air Propeller.

[*For discussion on this paper see page* 246.]

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*On "American Sanitation," by* JOHN B. GASS, A.R.I.B.A., Graduate, Godwin Bursar and Medallist of the Royal Institute of British Architects, &c.

IN the following paper I propose to give a general account of the leading methods of Sanitation adopted by American architects and engineers, noted by myself during a professional visit to America last year. Having had the honour of being elected by the Council of the Royal Institute of British Architects to the Godwin Bursary and Medal for 1885, I travelled with official letters and introductions to examine into and report upon American methods of building, construction, arrangements, sanitation, &c. My report on the latter subject, though probably not presenting anything new to specialists, may, I trust, be of some little general interest.

It is only of late years that much attention has been given in America to the sanitary arrangements of towns and buildings, and the better understanding of what precautionary measures are necessary for the public health. Architects and engineers recognise the importance of sanitary matters, and manufacturers are stimulated to develope appliances to meet the latest sanitary requirements. The American public mind has been stirred in these matters, and the National Board of Health at Washington, and the Boards of Health of the various States, are doing excellent service. The reports of the Washington Board, which (I believe) are in the Library of the Sanitary Institute, and which I brought over for the Library of the Royal Institute of British Architects, contain information of much value, though unfortunately the last report is only of small dimensions, owing to the limited appropriation of money



granted by the Government. In many of the cities there are stringent sanitary regulations, which are very good, but, unfortunately, they are not always carried out, as the curse of the speculating and jerry builder hangs over America as well as England. Building Inspectors are not always able to insist on a full carrying out of their regulations, and perhaps even Building Inspectors have occasionally the "itching palm" with which the American public service is so much credited. In one city, where the plumbing regulations are very strict, I was told that the purchasers of a row of good houses, on entering into possession, found that all the elaborate plumbing fixtures were without any service or waste piping at all.

As the ordinary system of city drainage takes rain and storm water in addition to foul water, pipes and culverts of large diameters are used. In hot and dry weather, which often lasts for considerable time, when there is the greatest decomposition of sewage matter, there is no storm water to flush, and there is also a decomposition of filth in the street water catch basins. There is also the difficulty of ventilation, and the storm water makes an embarrassment in the treatment of the foul sewage. In some parts of Philadelphia the slop water from the houses discharges into surface gutters in the streets. These are very objectionable, particularly in hot weather, when the smell is very offensive, or in frosty weather, when the foul water freezes. Many of the American cities are badly drained, and the disposition of the sewage is often a matter of great difficulty owing to the sites of these cities being frequently flat. There are various ingenious systems for its treatment and disposition, but in practically the majority of cases it is turned directly into the nearest river, lake, or sea, without any treatment whatever.

The connection of any good system of house drainage to the ordinary main sewer is trapped, with "breather" pipe on the house side. This, where possible, is at some little distance from the house, and anyhow away from window or door: it is carried about five feet above ground, of good diameter, and with end turned downwards. In cities where the main drainage is only at the front of house and the closets, bath, &c., at back, it is necessary to run the pipes through the basement. This inside drainage is very common. The iron soil pipe passing through cellar is carried, if practicable, in full sight along the face of cellar wall, or suspended from the floor beams. If it is carried under floor it is encased in strong cement concrete with sealed hand holes for cleaning. Where passing through foundation wall, arched opening is left, and the iron pipe taken at least five feet outside, where it is connected with the earthenware drains. If the ground is not solid the iron pipe is carried

further and encased in concrete—this gives greater certainty of tightness and correct grading. When the trap disconnecting house drainage from main sewer is on the soil pipe, and inside cellar wall, it is of iron and fitted with cleaner, the breather pipe being carried outside to curb or fence wall, with gird at end.

The ordinary system of city drainage being very defective, it is interesting to note a departure from it in the sewerage of the city of Memphis. Here is the best known and largest example of the application of the result of the investigations in various cities, by order of the United States National Board of Health. In these cities, the main sewers were gauged to determine the actual size of pipes needed for the removal of the greatest amount of foul sewage matter only, produced under various circumstances. These gaugings (a full account of which was published in the Board's report for 1885, fo. 354) show conclusively that for foul sewage matter for a large population, main drains of only small diameter are necessary.

Colonel Waring, of Newport, R.I., the engineer who designed the Memphis sewage scheme, communicated a paper to the "Sanitary Institute," in September 1880, giving a full account of this work, which is no doubt familiar to the members. It has now been in use over five years, and the practical working appears to have been very satisfactory. To recall the main features, I may state that Memphis is a city on the Mississippi, of between forty and fifty thousand inhabitants. The main drainage system is for foul sewage only, and when complete will have a total length of about forty miles. There being very few cellars and the ground having a good natural fall, the drains were laid about 6 ft. deep. No outlet drain from any house was allowed more than 4 in. diameter, the tributary mains being 8 in. and 6 in. diameter, and the two mains commencing from 8 in. diameter, and increasing to 12 in. and 15 in. diameter, all being of socketted glazed pipes. The two mains are joined together into a 20 in. brick sewer, which has switches turning the drainage into a 3 ft. iron pipe for the high water outlet, and into a 20 in. iron pipe for the low water outlet, the extreme variation of level in the river being 35 feet. On the main lines, man-holes have been put in at intervals. No house connection is trapped, but each has an unobstructed ventilator reaching to top of roof; this gives vent to about every 30 feet of sewer. Every slopstone, water-closet, sink &c., has independent trap; hopper closets are insisted on, the sanitary regulations are very strict, and all plumbing work is inspected by engineers. The whole system is flushed daily or half daily with about 150 Rogers



Field's well known automatic flush tanks, supplied with town water, and placed at the dead end of every branch to thoroughly flush each length; each flush tank discharging about 100 gallons in 40 seconds thoroughly scours the pipes. The subsoil drainage is by agricultural drain tiles, 1 in. to 3 in. diameter, laid beside sewer and in the same trench; these discharge into the nearest water course, or on very level ground into the main sewer, with special precautions against sewer water backing up. Storm water is removed by surface gutters with outlets through shallow conduits easily accessible.

On this system there have been official reports by Mr. Gardener, for the Board of Health, New York State, and Mr. W. H. Baldwin, C.E., the latter dated March 29th, 1884. The following is a summary of these reports with regard to the working: "In the mains, from 10 in. and over, a deposit is found of fine silt, supposed to be mud and paper pulp; this is cleaned out about once a month by rope and steel brush being dragged through from man-hole to man-hole. In the lateral sewers there are very few stoppages; where stoppages occur they are from schools or shops only, and in pipes 6 in. diameter and under, and are caused by sticks or pieces of metal getting crosswise in the pipes. For stable washings catch pits have been found necessary. A few T cleaning pipes have been inserted, and hand-holes are now put in all extensions about 100 ft. apart. Some of the sewers are 2,000 ft. from the mains, and the longest lines generally run about quarter full. Overflows have had to be provided for taking the water in winter, when the water taps are left running in the houses to prevent them freezing. Neither in removing obstructions, in cleansing the main sewers, nor in connecting with house drains is the odour of sewer gas ever observed."

This system was adopted at Keene, N.H., and executed in 1882-3. I am informed that it is working well, though the greatest fall is only 4 in. in 100 ft., the lowest fall being $\frac{1}{10}$th in. in 100 ft., and that line nearly two miles long. It is also being used in parts of Paris and other places, and may, I think, on a large scale, be considered a success.

In the country districts, where there is no regular system of sewerage or convenient water course, house wastes are disposed of by means of cesspools, the commonest form of which is the "Leaching cesspool," which is only of use in sandy or gravelly soils, and should not be used where there is a chance of contaminating water supply. It is built circular, 8 to 12 ft. diameter, of depth requisite to reach an absorbent stratum, the sides lined with dry wall of stone or brick, and the top drawn over dome-shaped with man-hole at top—covered with loose flat

stone, and earth over. Subsoil irrigation is being much used, the sewage being conveyed to tight cesspool or tank, having outlets to irrigation field or surface by a series of open-jointed tiles. Rogers Field's automatic flush tank is used most successfully, as also are ordinary tight cesspools placed at a higher level and let off at intervals. The tight cesspool with overflow at top is also in use, but, as the sewage water is not delivered intermittently or in large quantity, it is not successful.

To prevent damp in cellars or foundations, under-draining is resorted to, and formed with agricultural drain tiles of small diameter, well graded, and laid, with "muslin" joint or paper cap, below level of foundation. This is kept separate from other drains, and discharges into water-course if practicable, or, if connected with main drainage, is carried some distance from house, and tiles stopped at least 10 ft. from connection, this length being filled in with very fine sand or gravel. When a gravel under-drain is used it is excavated for as tile drain, and bottom filled in to about 12 in. deep with sand or fine gravel.

To prevent ground smells rising in house 6 in. clay puddle or thick coat of asphalte is put under floors and rammed in at side of wall.

*Plumbing.*—Lead is mainly used for plumbing in England, but in America iron takes its place, being used for soil pipes, supply pipes, and wastes, except in cases where there are many bends, or in branches of small diameter.

The soil pipes are generally of cast iron of extra thick metal with turned socket joints, made with oakum driven in tight and finished with melted lead, which is tightly caulked after being run in place. Joints are also made with sal-ammoniac and iron filings; turned socketted cone joints are used and flange joints, bolted together, with lead washer, star-shaped in section, which flattens out when bolted up and forms a good joint. Wrought iron soil pipes, in long lengths with bolted flange joints, are also used. The soil pipes are usually coated with asphaltum, inside and out; some are enamelled inside or dipped in patent solution, of which there are many sorts.

Owing to the severity of the weather in winter it is often necessary to keep the soil pipe inside the house or inside "plumbing tower," heated in winter: it is used as the waste for all the plumbing fixtures, the pipes being prepared with the necessary Y branches for connections. Where lead pipe is connected with the iron a tinned brass joint-piece is inserted, caulked to iron pipe, and the lead pipe connected to it by a wiped solder joint. Under ordinary circumstances 4 in. soil pipes are generally found sufficient; in 3 in. pipes there is better flushing, but greater danger of syphonage upon lateral



branches; this danger decreases by the use of larger pipes, being in inverse proportion to the diameter of pipe.

The soil pipe runs up to the roof of full diameter, then for a length at least on the outside of greater diameter, using an increaser joint of 4 in. to 6 in., which is said to give effective increase to the movement of air. At the top a spherical wire basket is placed to prevent obstruction. Ventilating cowls or covers of any sort are objected to by many as obstructing the current and increasing the friction, particularly so during calms or light winds.

The soil pipes are carefully tested under hydraulic pressure, or by air pump and pressure gauge as used by gas-fitters; the plumbing fixtures are afterwards tested by the usual peppermint or smoke tests.

Extreme simplicity of plumbing arrangements is advocated, and in some very large houses I visited, carefully carried out. The water-closet is arranged to do duty as urinal, slop-sink, &c., and water drawn by housemaid from bath taps or stand pipes. All wastes and traps are exposed to view with absolutely tight blocking for every pipe hole, and no wood casings to closets, wash-stands, or bath. For water-closets the seat is formed of hard wood, on cleats at sides, and hinged to be turned back. Most of the water-closets are imported from England—the Brighton, Jennings', Hellyer's, and others being in use. The distinctively American ones are cleared by syphonic action; the "Dececo" is on the principle of Field's Flush Tank, and seems to answer very well, but the trap cannot be ventilated, as it would interfere with the formation of vacuum before the syphon will act. There are others on the same general lines of varying values, some of which are arranged with air pipes to traps, which are kept closed by valve, except in case of under-pressure.

Urinals are rarely found except in hotels and public buildings.

The bath tubs are ordinarily of tinned and planished copper, 16, 18, and 20 oz. metal; they are also used of iron, enamelled or painted, while the earthenware ones are imported from England. In the overflow to bath tubs, as ordinarily arranged in English baths, the dirty water rises to same height in it as in the bath when let off; it therefore gets fouled, and not getting flushed is a frequent cause of bad smells. In many baths in America there is no overflow at end, but copper or brass stand pipe, the height for water, fits into outlets and serves as plug.

Wash-basins are in single pieces of earthenware, with several patent overflows and wastes; the stand pipe overflow is in use for these, the basins being drained from the back, with the

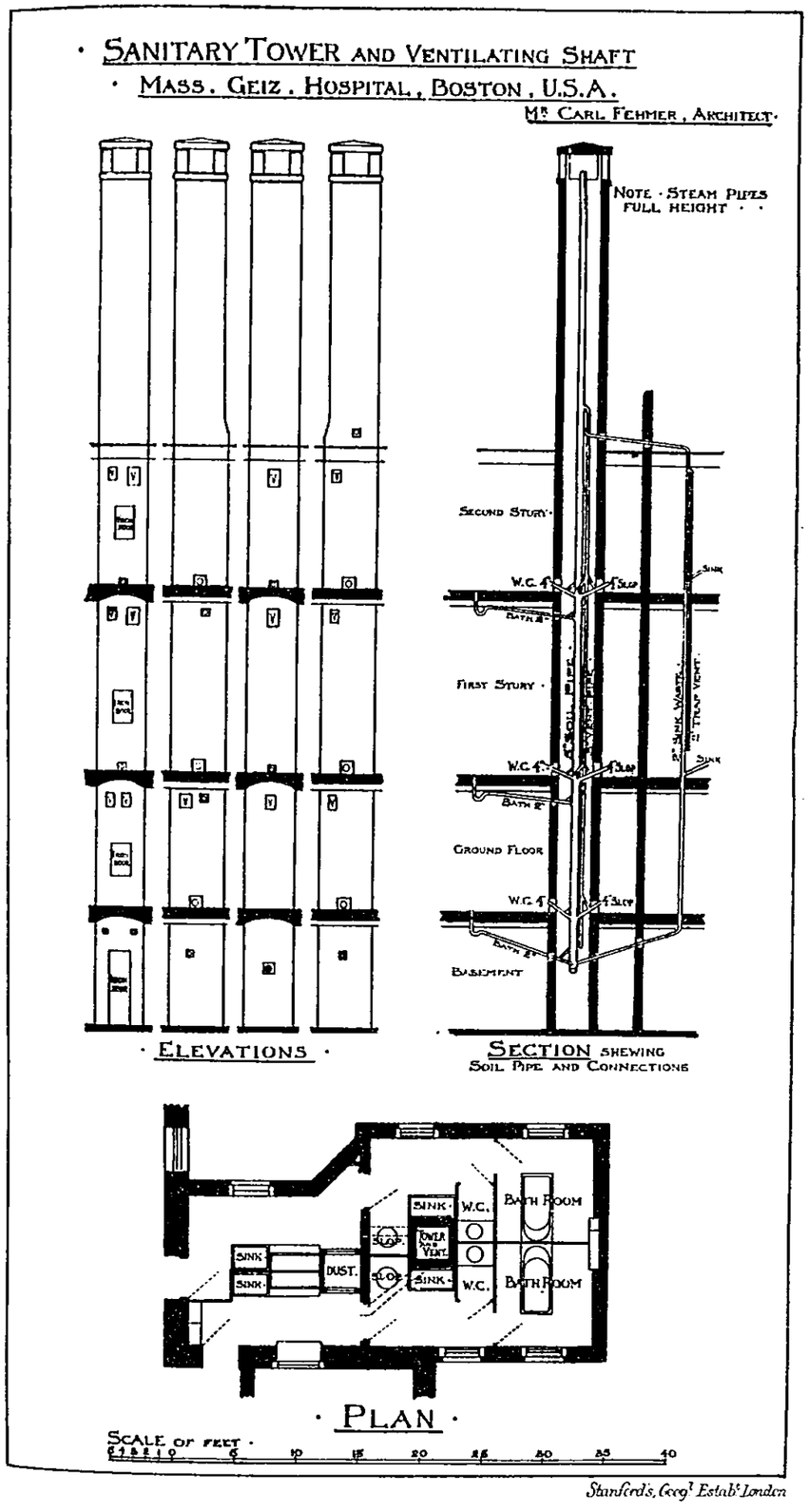
stand pipe in recess, and raised or lowered for outlet by small lever at top of basin. Kitchen sinks are the same as in England, and made of metal or porcelain, with outlets as used in wash-basins.

Each of the plumbing fixtures is separately trapped, there being many traps of varying value. The common S or V trap, with ventilation connection attached, is ordinarily used. Putnam's Sanitas trap is said to be made so that it cannot be syphoned; it consists of an adaptation of the S trap, with the water passage diverted by a bent plate, causing it to flow round a strong glass bowl let into side. It has no moving parts, is easily cleaned, the interior being exposed to view and holding a large quantity of water; the water seal cannot be readily broken. There are several traps having movable parts, usually with ball valve, but these are always liable to get out of order.

To kitchen sinks numerous forms of grease traps are used: the ordinary one is outside in yard, forming a settling pit and with cleaner on top. The "Dececo" flush pot is fixed underneath sink; it is made of glazed earthenware, inverted pear shape, and holds about six gallons. In the sink is the ordinary grid with waste, which discharges into the flush pot, at the bottom of which is also outlet with plug worked by lever from top of sink. When the pot gets filled the outlet from it is opened, the rush of water carrying everything with it and flushing the drain.

All the municipal plumbing regulations require that traps shall have back ventilation with air pipe not less than $1\frac{1}{4}$ in. diameter for small traps, or 2 in. diameter for large traps. The question of the back ventilation of traps is a point of contention with many of the leading sanitary engineers in America. The results of experiments by various engineers are published in the National Board of Health's Report for 1882 (folios 135 to 152), but unfortunately there is a complete divergence of opinion. If traps are *not* ventilated there is a danger from syphonic action and traps emptying for want of air. When traps *are* ventilated the danger is from destruction of water seal by evaporation, or from aid to trap emptying by capillary attraction when any hair or material gets over the edge of trap. Further experiments are, I believe, being conducted on this vexed question.

At the Mass. Geiz. Hospital, Boston, a Sanitary Tower and ventilating shaft has been recently built for the wastes from hospital plumbing fixtures; it is an addition to the old building and there was only a limited site. The tower is 2 ft. 9 in. square inside, and carried 24 ft. above top floor ceiling, with flag cover at extremity, the outlets being at sides. It serves



for two distinct sets of plumbing fixtures, and allows easy access to all the pipes. Wash-basins, sinks, and water-closets are grouped round it, with the baths between water-closets and end wall. A 5 in. soil pipe is fixed in tower and runs full height, with a 3 in. ventilating pipe parallel to it and turning into it above highest connection. Steam pipes from the heating apparatus are taken up the full height, allowing a good flow and return. All the wastes are separately trapped, and discharge into soil pipe, with vent near connection into main vent pipe. There are 4 in. outlets from water-closet and sink, and 2 in. from bath trap, the waste being under ceiling. The inner sink has 2 in. waste, discharging into soil pipe at bottom, and connected with it as vent above ceiling line of top floor, each inlet into this having separate vent connected with continuation of waste below top ceiling. The pipes were all carefully planned and holes left in the walls; these were afterwards solidly built up. The steam pipes in tower prevent any possibility of the wastes freezing, and cause a continuous upward current of air. There are ventilating flues, exhausting into tower where there is any possibility of smell or steam being offensive.

The water supply to cities is from various sources—ordinarily from the nearest river or lake, which, being at a low level, necessitates the use of pumping stations. At Chicago a tunnel is driven under Lake Michigan, with inlet some distance from the shore, the water flowing to pumping station and there forced up large stand pipe. At Philadelphia the supply is taken from the River Schuykill, quite close to the city, the land for 12 or 14 miles on each side of the river having been acquired and formed into the beautiful Fairmount Park. This park, to some extent, keeps the river free from objectionable drainage, but not altogether, the cemeteries, for example, draining directly into it. Dr. Billings says, in a recent article, that the cities whose water supply is more or less polluted by sewage are so numerous as to form the rule rather than the exception.

It is of some interest to note that although a better water supply is contemplated at Philadelphia, and the reservoirs are partially made, the work has been for the time abandoned, owing, I am told, to causes which unfortunately too often interfere with public works in America, and also to the necessity for the city fathers being economical in everything except the new public buildings, whereon they are lavishing immense sums of money.

The water supply pipes to buildings are of various metals, but ordinarily of drawn lead tinned inside. Seamless drawn brass tubing is largely used, particularly where the pressure is heavy

or the water very soft. For cold water the pipes are tinned inside, but this is not necessary where the water is not used for drinking purposes or for hot water supply. Where exposed to view all brass tubes are coated with tin, plated or varnished with shellac. Wrought iron water pipes are also extensively used, the inside being galvanized, enamelled, lined with tin and occasionally glass lined. Other protecting mediums are of coal tar or paraffin enamel, and of course there are many patent solutions, one having a base of vulcanized rubber. Iron pipes are sometimes zinc-cased outside, particularly when exposed or where possible leak would do injury. In fixing, the horizontal pipes are secured by stout brass bands screwed, while vertical pipes have ears soldered to the pipes and screwed.

It will be understood that the methods of sanitation before described are not in general use throughout the country. The remarkably rapid growth of most of the western cities, and the natural difficulties of the disposal of refuse, conjoined with the general apathy in matters of sanitation, from which both Americans and we ourselves are only just emerging, leave a great deal to be done everywhere, and it must take many years to bring most of the American cities into a thoroughly sanitary condition. Even in so enterprising and wide-awake a city as Chicago, for example, behind the fine houses in its famous Michigan Avenue there is hardly a single house, I am told, where proper provision is made for the disposal of the refuse of the household. The decaying vegetable and animal matter is simply thrown into the unpaved back street, or on to the nearest unoccupied ground and allowed to lie and rot there. At all times these alley-ways are filthy, and in hot weather they are both disgusting and a source of great danger.

But the American public mind is rapidly awakening to a recognition of the necessity for proper sanitation, and, with its hospitality to all new ideas, the inventive genius of the people, and their insatiable desire for "progress," I think it is very probable that they will move much more rapidly than we shall be able to do in our own country, with its conservative instincts and its archæological love for the "dear old cesspool."

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[*This discussion applies to the three preceding papers by* Mr. J. V. Edwards, Mr. W. Tattersall, *and* Mr. J. B. Gass.]

Mr. E. C. Robins, F.S.A. (London), was the first speaker. He said he had listened with great interest to the three papers, which were intimately connected with each other, and the various subjects had been



thoroughly considered. They were much indebted to Mr. Gass for his paper on American Sanitation. It was well known that some of the back streets, and also some of the principal streets, of Chicago were a disgrace. He thought the paper read by Mr. J. Vickers Edwards was characteristic of the man; great care had been taken in its preparation. Mr. Gilbert Scott, the celebrated architect, did not know much about sanitation; his mind was occupied with the artistic side of his profession, and very well did he do that part which was particularly his sphere, but sanitary arrangements were left to his subordinates. It was no doubt true that architects, some years ago, had not the knowledge of sanitation that is possessed at present, and they had no inducement to make it their study; but the young architects of to-day would have no such excuse, for much knowledge on all sanitary matters was now open to them, and he thought any architect neglecting to provide perfect sanitary arrangements, could not in future excuse himself on the ground of deficient information. He considered the internal sanitary arrangements of the house should be regarded as a special part of the architect's duty. The drains of houses and public sewers should both be properly separated and dealt with apart from each other. The engineer should consider the ventilation of the sewer important to him, and the architect should consider the ventilation of the house as important to him. With reference to the paper read by Mr. Tattersall, he remarked that the people of this country owed too much to the working classes not to give them pure atmosphere to enable them to carry on their work, and the system of extracting fans recommended in the paper was sound, provided there was a corresponding supply of fresh air.

Mr. M. Ogle Tarbotton, M.Inst.C.E. (Nottingham), congratulated Mr. Edwards upon his excellent paper. He had a most pronounced sympathy with his remarks about heavy and excessive furniture and stuffy rooms.

Mr. Rogers Field, M.Inst.C.E. (London), agreed with what Mr. Tarbotton had said with regard to Mr. Edwards' paper, and said that the influence of a gentleman in Mr. Edwards' position—that of surveyor to the West Riding—must necessarily be very large in advancing sanitation.

Mr. T. Harnett Harrisson (Liverpool) spoke from personal experience as to whether the public appreciated and were willing to pay reasonable rents for well-arranged houses. He had built four, in which he carried out complete sanitary arrangements, but he could not let them at a reasonable rent, because some other houses of a more showy description, and with, perhaps, one room more, could be had for less money. That being so, he asked if the speculative builders were likely to provide better houses for the public until they were more appreciated.

Mr. G. Darley (Leeds) regretted that so few sanitary inspectors were present, and spoke of the difficulty they had to contend with.

Referring to the smoke nuisance, he said that frequently many members of corporations were either manufacturers or iron masters, and consequently they were the very persons whose chimneys created most nuisance, and it was necessary for the inspectors to take independent action. He complained of the scarcity of information on the consumption of smoke. There was great difficulty in connection with the matter, and he hoped that soon some good papers would be read on the subject.

Mr. J. B. Gass (Bolton), speaking with reference to the ventilation of mills, said that the ordinary method was by means of inlets at a low level for the admission of cold or partially warmed air, and outlets near the ceiling or on the roof through which the hot air necessarily escaped. He gave an instance where, on inspecting the ventilation of a mill during the summer months, he found the ventilators for the purpose of admitting air all blocked up with waste, &c., because of the natural objection of the workpeople to the admission of fresh cold air. He referred to one or two cotton mills in America, and also to a large block of workshops in New York, where under the centre of each block is a large ventilating chamber, to which air is brought down through a shaft, the top of which is about forty yards from ground. The fresh air is warmed when required by passing over steam radiators, the amount of steam in the pipes being regulated by a "Fractional Valve": it is then put under pressure by fan into large duct, and distributed to the rooms through galvanized iron ducts, with inlets into the rooms at about eight inches from the ceiling, and having hoods over to spread the air. The foul air is extracted through flues built in walls and exhausted into large flue. Outlets from the rooms are placed near the floor and ceiling, the former being wholly used when warm air is admitted into the rooms; the latter outlet is only used during the very hot weather, and when it is necessary to keep the workshop as cool as possible. The inlets are larger than the outlets, so that during the whole of the time the workshops were in use, and warm air was being admitted, there was a continual outward pressure, and draughts from the windows, &c., were prevented.

Mr. Denham gave an account of the very unsanitary condition in which he had found several large houses, and which he held proved the necessity of a thorough examination of the sanitary arrangements.

Mr. D. Emptage (Margate) said he could not agree with the practice of connecting the wastes and overflows from baths, sinks, and lavatories with the W.C. soil pipe, as was done in America. He thought the system of separate wastes with disconnectors, as carried out in England, was far preferable. The soil pipe should be allowed to receive the discharges from the W.C's. and slop sinks only. He was pleased to find that in Memphis the use of the "Hopper" form of closet was insisted upon, as he considered it to be superior to those kinds which had their trap seals out of sight. The closet referred to as "distinctly American," the "Dececo," had some good qualities; it was, however, open to the objection that its trap seal was in danger of being lost when large quantities of water were discharged into the basin, and there seemed to be no remedy for this defect without entirely destroying the siphonic action of the closet, which was its main feature.



Mr. W. Tattersall (Bradford) replied to the various observations, and said that the system suggested by Mr. Gass, of forcing warm air into workrooms near the ceiling level, and extracting the foul air at the floor level, would be impracticable in many factories, owing partly to the difficulty of securing proper distribution for the entering air, and more to the difficulty of obtaining outlets at the floor level, sufficient in quantity and in the proper positions, in large rooms the floor spaces of which were almost entirely covered with machinery. As to the operatives being taxed to secure better sanitary conditions, the idea seemed to him impossible, and in his opinion any outlay the employers made in that direction would be amply repaid by the extra amount of work the operatives, who would enjoy better health, would accomplish. Some employers were acting on the enlightened view of the case, with the best results.

Mr. J. Vickers Edwards (Wakefield) expressed an opinion that if manufacturers found persons in earnest about the smoke nuisance they would soon remedy it. He spoke in favour of the use of fans for removing foul air.

The Chairman, Mr. Baldwin Latham, in moving a vote of thanks to the three gentlemen who had read papers, said the sanitation of dwellings was a very important question, and the most hopeful sign of the present day was the interest that the working classes were now taking in it. They were beginning to realise that their health was their capital, and that there was a value in teaching the principles of hygiene and physiology in the elementary schools.

Dr. A. Hill (Birmingham) seconded the vote of thanks, and expressed an opinion that a large amount of the smoke nuisance was owing to carelessness on the part of the stokers, and could be remedied by careful "stoking." The motion was carried unanimously.