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INTERNATIONAL HEALTH EXHIBITION

LECTURES.

SMOKE ABATEMENT.

A Lecture delivered in the Lecture Room of the Exhibition, July 21st, 1884.

BY ERNEST HART,

Chairman of Council of the National Smoke Abatement Institution, and of the National Health Society.

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LECTURE ON SMOKE ABATEMENT.

By ERNEST HART,

Chairman of Council of the Smoke Abatement Institution, and of the National Health Society; Member of the Executive Council of the International Health Exhibition.

SIR FREDERICK POLLOCK, Bart., in the Chair.

THE CHAIRMAN, in introducing the lecturer, said the subject of smoke abatement was one of very great importance, and one to which Mr. Ernest Hart had devoted a great deal of time and attention. By the ability and energy which he had shown in initiating and directing the work of the Smoke Abatement Committee, he had done a great deal towards reducing the nuisance of smoke in London. However, still more remained to be done; activity on the question was going on on the part of the Smoke Abatement Institution, into which that Committee was now transformed, and the desirable thing now was to diffuse all the information possible, to point out the best remedies and to induce the public to adopt them. With a view to extending knowledge upon this subject, Mr. Hart had been good enough to come this evening in order to give any assistance that he might be able.

MR. ERNEST HART: There are so many sides upon which the question of smoke abatement may be considered, and there is so much to be said both from an historic point

of view and from the point of view of present action, that it is impossible that I should treat all parts of the theme in the short half hour to which these lectures are in mercy to their audiences usually confined. I shall not therefore to-day say much upon one aspect of the subject on which it is, however, extremely and essentially necessary that there should be some public enlightenment, I mean the subject of combustion generally, but I shall refer to the present and past position of smoke abatement as an administrative and legislative, rather than as a purely scientific movement. I have some hopes that other members of the Smoke Abatement Institution, specially well qualified to deal with the scientific part of the question, such as Professor Chandler Roberts, or Captain Douglas Galton, will, at a later date, deal with the technical side of the question.

The question is not a new one in this country, but has a history extending back nearly 600 years. We find that in the year 1306, when coal had come into considerable demand in London, Parliament complained of the injurious effects to health and property arising from the use of coal, and the king adopted an effectual means of checking the evils arising from smoke, for he absolutely prohibited the use of coal. Later on, in the reign of Elizabeth, a motion was introduced into Parliament to prohibit the use of coal on account of the noxious vapours and smoke arising from it, which were considered very prejudicial to the health, especially of persons who were unaccustomed to it.

From this time the minds of public and scientific men were occasionally exercised in protesting against the evils of smoke production and in devising suitable means for its abatement. But it will only be necessary to allude to Sir Hugh Platt in 1594, to Evelyn's eloquent protest in his *Fumifugium* in 1661, to Benjamin Franklin's efforts in 1745, to those of James Watt in 1795, and Count Rumford in the first decade of the present century, in their well-sustained warfare against smoke and its attendant evils. In 1819 the national importance of the smoke question was admitted in a very practical way by the appointment of a

Select Committee of the House of Commons, "to inquire how far persons using steam engines and furnaces could erect them in a manner less prejudicial to public health and comfort." The Committee reported that "so far as they had hitherto proceeded they confidently hope that the nuisance, so universally and so justly complained of, may at least be considerably diminished, if not altogether removed." In 1843, another Select Committee "inquired into the means and expediency of preventing the nuisance of smoke arising from fires or furnaces." The list of witnesses examined by the Committee comprised the honoured name of Faraday, and, as their Report points out, "they received the most gratifying assurances of the confident hope entertained by several of the highest scientific authorities examined by them that the same black smoke proceeding from fires and private dwellings, and all other places, may eventually be entirely prevented." They concluded by recommending "that a Bill should be brought into Parliament to prohibit the production of smoke from furnaces and steam engines." In May 1845 yet another Select Committee of the House reported "that in the present state of knowledge and experience upon the subject, it is not desirable to extend the provisions of an Act beyond furnaces used for the generation of steam."

In August 1845, Sir Henry de la Beche and Dr. Lyon Playfair reported to Lord Canning "that it cannot for a moment be questioned that the continued emission of smoke is an unnecessary consequence of the combustion of fuel, and that, as an abstract statement, it can be dispensed with." They added, however, "it is useless to expect, in the present state of our knowledge, that any law can be practically applied to the fireplaces of common houses, which, in a large town like London, contribute very materially to the pollution of the atmosphere."

It was not, however, till 1880 that a substantial attempt was made, by the National Health Society at my instance and with the co-operation of Miss Octavia Hill on behalf of the Kyrle Society to organise public opinion and scientific

research; nor was it till the formation of our Smoke Abatement Committee in 1880 (see *Sanitary Record* for Nov. 15, Dec. 15, 1880, and Jan. 15, 1884) that any substantial effort was made to ascertain what the present state of our knowledge of the subject generally really is. An interesting series of reports published from time to time mark the stage of progress which has now been reached, and I shall have occasion later on to show how abundant have been the results of the labours of this Committee during the three years that we have been at work; one result of their work is shown in this Exhibition and elsewhere by the large number of persons, representing all classes and interests, who are now fully sensible of the importance of the subject; and, further, there is abundant and satisfactory evidence, in London and in the chief provincial towns, of anxiety to adopt any improved appliances for burning fuel, or any smokeless forms of fuel, when their merits have been fairly proved.

The Smoke Abatement Exhibition which we organised in 1881 (see *Sanitary Record* for Dec. 15, 1881, Jan. 15 and Feb. 15, 1882), in part of these buildings placed at our disposal for the purpose by the Royal Commissioners, with the approval of the authorities at South Kensington, stimulated and encouraged inventors, manufacturers, and others, and aroused a healthy spirit of competition in the production of smoke abating appliances. At the Smoke Abatement Exhibition, buildings were fitted up for the purpose of testing the efficiency of grates, stoves and other appliances suited for domestic use; and trials of various fuels and boiler appliances were also provided in the Exhibition buildings, in the Royal Albert Hall, and at certain factories where facilities were afforded. This series of mechanical and physical tests were conducted by Mr. D. Kinnear Clarke, C.E., and the chemical investigations on the effluent gases of the flue by Professor Chandler Roberts, F.R.S. The results obtained by these gentlemen and by their competent assistants were of a unique kind, and no pains were spared to ensure their completeness. The results are preserved in

a permanent form in the Report of the Smoke Abatement Committee of 1882, published by Messrs. Smith, Elder & Co.* It would be well if architects and others officially concerned, and all persons whose duty it is to determine on the question of rates, were to consult that report. Quite recently I found that two of my friends had placed themselves in the hands of eminent architects and asked them to fit up suitable grates for the prevention of smoke. In one case the gentleman who stands in the foremost rank of his profession frankly avowed himself ignorant of the subject and under some unhappy inspiration chose for this new mansion the class of grates which was shown by the test at the Smoke Abatement Exhibition to produce the very worst results, and in the other case the architect, who was one of the most eminent architects in the kingdom, said he did know all about the subject, and yet, strange to say, he chose the same grate, which proved that he had never even looked at the results which had been obtained, and was still in a state of dense ignorance of the results actually achieved, and of the facts proved. Only two days ago I met in this Exhibition a gentleman who is the architect and adviser for one of the largest building estates in the kingdom, and I found he had never read this report or ascertained what were the results arrived at upon the subject. He asked me, "Have you come to any result—what can I advise, is there any grate at all which will lessen smoke? Have you got any result?" He was so great a man that I did not like to tell him the results had been under his eyes for some time, so I promised to take him over the present Exhibition and point out some of the results of the Smoke Abatement Exhibition of 1881, and to bring under his attention some of the successes which had been attained. That is not very encouraging, but I can only hope that as we have made those results available to the public, and as our opinion can be brought to bear upon these learned gentleman—learned in their own profession and able to appreciate,

* These results are discussed and summarized in the *Sanitary Record*, for Feb. 15, 1883.

although regardless at present of the results obtained by others—that they will give attention to those results. I am bound to say that I consider it not altogether creditable to the Royal Society of Architects or to any of the great architectural societies, that some one of their members has not abstracted and criticised for the use of these societies the practical results which have been obtained by these physical and chemical tests, and that architects as a body seem at present to be quite unaware of their extent and importance, and to have learned none of the lessons which are clearly set out. I venture upon this somewhat strongly worded expression of opinion because, with the great respect which I have for those gentlemen, I believe that practically at the present moment it lies very much in their hands whether the information and the conclusions which we have obtained shall be buried, or whether they shall be vital and progressive and lead to the great results they are capable of leading to, especially with respect to new houses. I think it little less than a scandal that, notwithstanding the promises which have been made to us by the heads of many of the Government Departments, no systematic steps have yet been made, and more particularly by the Department of which my distinguished and able friend Mr. Shaw-Lefevre is the head, to apply these results. Some time ago trials were carried on at the Arsenal and very good results obtained, of which the First Lord of the Admiralty must have had cognizance, and yet no steps have been taken to make the results available either for the Institution or the Arsenal, to which it was promised they should be made available, nor to any of the ships of Her Majesty's Navy. When I had the honour of going through the Exhibition with that most intelligent and distinguished lady the Empress Eugenie, I found she was not only extremely interested in the question from the domestic and sanitary point of view, but she at once said, "This is a matter of great importance to ships of war, and that is what interests me. When a steamer is seen at a distance the first thing you see, and the first thing which gives notice to an enemy

which approaches, is the steam coming from its funnel." She said, "I feel interested in this for the sake of the war vessels as well as for the sake of the ordinary abuse in the production of dense smoke in steamers which traverse the rivers of our great towns." I am bound to refer to these instances, owing to the indifference shown to the results already obtained, because I believe that nothing but a strong public opinion brought to bear upon the heads of departments, and upon the respective technical professors, and the respective professional men employed in the construction of houses and the sanitation of cities will make the results which we have obtained fructify, or will lead to the progress of which the first elements are undoubtedly already practically furnished in this most valuable report.

In the remarks which follow, I propose to deal: 1, with the objections which have been raised to the prosecution of the movement; 2, to trace the steps which have been taken in collecting evidence as to the extent to which the evil exists, and the possibility of abating it; and to indicate the individual efforts which appear to be demanded by the evidence adduced; 3, to offer a brief statement as to the results which have been attained and are within reach.

Some objection has been made to the movement, on the ground that it is not a new one, and that the public have had the evils arising from smoke so fully brought before them as to render unnecessary the formation of a society for the purpose. It is true, as we have already seen, that the movement is not a new one, as it existed in a crude form from a very early period. Royal proclamations prohibited the production of smoke, and various appliances for preventing its production were devised, but until the formation of the Smoke Abatement Committee, over which I have had the honour to preside, in virtue of my labours in initiating it, the subject had never been treated as one of public importance, and even national interest, nor had the description of the extent and character of the evils associated with the production of smoke been brought in a clear and definite way before the public.

It has further been urged that since the continuous efforts of our forefathers for more than five centuries have been ineffectual in devising an acceptable and efficient means of burning coal smokelessly, therefore the problem may be regarded as incapable of practical solution. If any argument were needed to refute so illogical a conclusion it would be found in the present advanced state of our scientific and technical knowledge as compared with that of even a century ago.

It has been urged that the saving in fuel is small and does not become an inducement for the adoption of smoke abating appliances. This is sufficiently disposed of by facts of which I purpose putting one or two before you.

In the Report of the Smoke Abatement Committee you will find it stated that the whole of Messrs. Minton's great potteries and porcelain works are being conducted practically without smoke, and at a saving in fuel and labour amounting together to about 40 per cent.: a careful account of about 5,000 firings under the new system showing a saving of about 20,000 tons of coal of the value of upwards of £10,000, and in addition to this there is a saving in wages and a better production of ware. These facts do not come to us secondhand or of doubtful authority, but are set out in a detailed statement made by the manager of the works, with the assent of the firm, at a meeting at Grosvenor House which they attended for the purpose.

Mr. Alexander Fraser, the manager of Messrs. Hanbury's brewery in the East End of London, has borne like testimony at a meeting held by the Smoke Abatement Committee at the Mansion House, to the facility with which they have, during a long series of years, conducted the operations of their business smokelessly, and to the saving amounting to £80,000 in about thirty years, which they had realised in the cost of coal.

A large firm of sugar refiners at the East End have since our Exhibition fitted an improved furnace to their boilers of 100 H.P. (tubular type). They now state that

they "find the smoke burnt perfectly, and a saving of coal, which, in this particular case, amounted to 40 per cent. of the coal burnt."

There were recently estimated to be 4,000,000 chimneys in London, about 5,000,000 tons of coal being annually consumed. The coal wasted was put at a million sterling, while Mr. Chadwick estimated the additional loss arising from the damage caused by smoky atmosphere, at two millions.

The late Dr. Angus Smith says, with regard to the use of coal for industrial purposes, "The ammonia from 1,000,000 tons of coal, if used in manure as ammonium sulphate, would add about £533,000 worth of food to the produce of the land; while, if the ammonia from all the raw coal now burnt in this country was utilised in agriculture, we should add £50,000,000 worth of breadstuffs, and might begin to export." (See *Sanitary Record* for April 15, 1881).

The First Commissioner of Works, the Rt. Hon. G. J. Shaw-Lefevre, said (speaking at the Mansion House), "I may mention as an illustration of the cost of renovating our public buildings, that one public building alone, the Houses of Parliament, costs the country £2,500 a year for the renovation of its exterior alone, owing to the destruction of the beautiful carved work, caused by the rain-water being so highly charged with carbonic acid gas; and I have no hope that cost will be diminished until some remedy is applied to the smoke grievance."

Professor Chandler Roberts, F.R.S., has shown by a course of carefully conducted tests of the gases or smoke given off from domestic grates of various forms, that the weight of the smoke cloud which daily hangs over London may be estimated at about 50 tons of solid carbon, and 250 tons of carbon in the form of hydrocarbon and carbonic oxide gases.

The value of coal wasted from domestic grates in London alone, calculated from the average result of the actual tests made by the Smoke Abatement Committee, reaches upon the annual consumption of five million tons, £2,257,500,

that is, reckoning the value of the coal at 21*s.* per ton only, and assuming that all the grates in London are equal to the average of those tested at South Kensington, which showed that 42 per cent. of the total heat generated passes away without being in any degree utilised in warming the room. It must be remembered that the conditions under which these tests were made, were much more favourable (say in respect of careful stoking) than would be present in ordinary use, where the loss would consequently be proportionately greater. Beside loss of coal, great loss of labour and cost of haulage, there are all the other attendant evils of a wasteful system. In money loss, the cost of cartage of the coal wasted in our domestic fires alone, taking the basis of the figures already given, amounts to £268,750* annually, while the unnecessary passage of about a million and a half of horses through the streets to draw this wasted coal, adds very seriously to the cost of street cleansing and repairing. To this should be added the cost of taking away ashes (20 per cent. of cinders is a low estimate) from the wasted coal, which amounts to £43,000 a year. I give these figures as approximate and estimated calculations, having a certain value in reference to the obvious objection that the cost of adopting grates or furnaces of a smoke-abating type is an unreasonable objection from the economic point of view.

Obviously there is nothing substantial in the objection as to the smallness of the waste, which has sometimes been put forward, inasmuch as overwhelming evidence proves that where black smoke is seen, combustible gases of greater heating value than the percentage of carbon in the smoke are also present, and moreover the measure of waste does not consist in the value of the combustible constituents of the smoke, but very largely in the heat which escapes unutilised from the defective method of conducting combustion, of which smoke is the visible sign, and secondarily in the damage which the smoke itself causes to property of various kinds.

* 2*s.* 6*d.* per ton on 215,200 tons.

Another set of objectors urge that to prevent smoke in our towns would be to remove a valuable antiseptic agent, the soot. Mr. J. G. Romanes, F.R.S., speaking at a meeting held at Grosvenor House, said on this subject, "It had been said, and it was quite true, that carbon was antiseptic in some relations; but it would be absurd to suppose that it was antiseptic in all its relations. There could be no doubt that if they were to exclude smoke from our towns altogether, they would increase the longevity of the inhabitants. He thought there were many present who, like himself, would be shortly glad to exchange the town for the country, and feel no regret at leaving the smoke, with all its antiseptic influences, behind them."

It has been said by some that in suppressing smoke we deprive ourselves of one of the most powerful disinfectants, and thereby nourish disease in our over-crowded cities, but as a matter of fact, infectious diseases have been proved by the statistical evidence, of which I shall here adduce a summary,* to be more prevalent, in proportion, in large manufacturing towns, where smoke abounds, than in country towns and rural districts.

In fact, the medical evidence as to the deleterious character of smoke is very emphatic, and has completely changed the aspect of things from the point of view of the public.

Sir Wm. Gull writes to me in a letter which I have had his authority to publish, "It is clear that smoke and fog, not only touch, but kill the life of man." Sir Andrew Clark, Sir Henry Thompson, Sir T. Spencer Wells, Prof. Corfield, Dr. Ransome (of Manchester), and other eminent medical authorities have added their testimony.

Sir Andrew Clark writes to me: "I for my part have no manner of doubt that a smoke-laden atmosphere exercises an injurious influence upon the health, moral as well as physical, of those persons that dwell in the midst of it. A smoky atmosphere, both by its exclusion of light and by the irritating particles suspended in it, is hurtful to the

* See Appendices.

lungs and air passages; it aggravates the discomforts of sufferers from heart disease; it deepens the distress of the nervous; it lowers the tone of the general health; it adds perils to the sickness of the aged; and it materially diminishes that brightness and buoyancy of spirits which contribute so much to the power and the gladness of life."

Dr. Dudfield, President of the Society of Medical Officers of Health, in his last annual report on the health of Kensington, remarks: "The mortality would have been less than it was, had it not been for the contaminated and occasionally poisonous condition of the atmosphere—poisoned not by the 'disease germs,' on which so much has been said of late years, but by irritating and devitalising London smoke, the deleteriousness of which will increase with the growth of the metropolis, until measures are taken to abate the augmenting nuisance and danger. This was forcibly illustrated by the returns for last February. We were then the victims of fogs of unusual density, offensiveness, and duration, and the deaths in London from diseases of the respiratory organs were concomitantly 746 above the average. That is to say, in that month alone nearly 1,000 people died of smoky chimneys—for that to these the fogs are due is doubted by no competent person. The effects of the same pernicious cause were manifested also in other ways. Four of the zymotic diseases in Kensington, which are specially liable to be fatal from chest complications, or specially affect the organs of respiration were above the average." Scarlet fever killed 58, as against an average of 57; measles 77, as against 73; and whooping cough 119, as against 99; and diphtheria was registered as the cause of 25 deaths within the limits of the parish, the decennial average being only 20. The other deaths from diseases of the chest were, again, 91 more than in the previous year. "They are always more fatal," observes Dr. Dudfield, "when fog, especially London fog, is associated with cold."

During the five years, 1868-73, the average death-rate from diseases of the respiratory organs was 2·27 per 1,000

in Westmoreland (one of the healthiest counties in England) and 2·51 in North Wales.

For the whole of England and Wales it was 3·54; for Salford, 5·12; and for the Registration district of Manchester, 6·10. Taking, however, the township of Manchester alone, it appears that in 1874, the last for which returns have been published by the Registrar-General, the death-rate from these diseases amounted to 7·7 or three times the average of healthy districts, and more than double the general average for town and country districts—healthy and unhealthy. If, therefore, the rate could be reduced to the average for all England, there would be an annual saving of more than 700 lives in Manchester alone.

In 1873 the deaths in Westmoreland from diseases of the respiratory organs were 13·7 per cent. of the total deaths from all causes; in North Wales also 13·7 per cent.; in all England and Wales 17·2 per cent.; in Birmingham, 18·2; in Liverpool, 18·7; in Sheffield, 21·0; and in Manchester, 21·6 per cent.; but excluding the out townships, the rates in the township of Manchester alone amounted to 23·2 per cent. It appears, therefore, that Manchester suffers more from diseases of respiratory organs than any other town or city in England; and it may be safely affirmed that if no means can be found of reducing the number of deaths from this class of diseases, it is hopeless to expect that any material improvement can be made in the general state of the public health, or any sensible reduction effected in the general death-rate of the city. (*Extract from Manchester and Salford Sanitary Association Report*).

All authorities who have investigated the question are agreed that, in the case of manufacturers, future legislation should deal with the sulphurous acid given off as from the combustion of coal in large furnaces, as a noxious vapour, and that a large part of the injury done to vegetation and to public buildings in the neighbourhood of such factories is due to the production of sulphurous acid. A good deal of the coal used contains 2 per cent. of sulphur, and if all

smoke was rendered invisible by complete combustion, there would still remain sulphuric acid to do its damage, which, although probably not great in the case of dwelling-houses, where the smoke is so much diluted, is undoubtedly very considerable from large factories. (See *Sanitary Record*, vol. ix. p. 345).

This is a question which concerns manufacturing towns especially. It is satisfactory to know, however, that the experiments of Mr. Estcourt, Analyst to the City of Manchester, and of Mr. F. F. Goodfellow, have proved beyond doubt that it is possible to free coal smoke emitted by works, etc., from blacks and acid gas vapours at a cost within reasonable bounds. A full description of this machine or smoke-condenser will be found, by Mr. Estcourt, in the *Sanitary Record* of September 15th, 1879. It is now, I believe, actually working at Hyde in connection with the furnaces of two boilers consuming about fifty tons of coal per week.

Some doubts have been expressed as to the effects which might be expected upon the mortality from zymotic diseases, if London were deprived of what some over-wise philosophers appear to consider as the antiseptic influence of creosote products of smoke on the atmosphere. I have, with the kind assistance of Mr. Humphrey, taken out from the mortality records comparative abstracts of the mortality from zymotic diseases in London, and in selected smoky districts during the last year, and compared these with each other and with the mortality of the rural districts, with striking results. (See Appendices.)

It has further been urged that it is visionary to attempt to deal with domestic chimneys, as the Englishman is inclined to look upon his house as his castle, in which he will not tolerate interference.

The obvious reply to this argument is, that though a man can hardly be prevented from poisoning himself by an excessive production of smoke, if he chooses to allow his chimneys to smoke downwards into his own apartments, he can have no right either legally or morally to poison the

atmosphere inhaled by those who have the misfortune to live in close proximity to him. Such an argument is indeed quite fallacious in view of the many restrictions under which he is put, both as regards the construction of his walls and his sewers, and in respect of infectious disease occurring in his household, and other matters which no less affect his neighbours than himself.

It may be added that his present liabilities to the community are pecuniarily far more onerous than any which would be imposed by the adoption of one of the many means for securing an abatement of smoke.

I now come to the second head, and will endeavour to trace the steps which have been recently taken in collecting evidence as to the extent to which the evil exists and the possibility of abating it, and to indicate the individual efforts which appear to be demanded by the evidence adduced. In the first place I wish to call your attention to the result of the tests as published in the Official Report of the Smoke Abatement Committee, which show that with gas, coke, and anthracite coal it is easy to cook and heat efficiently and economically and prevent smoke *absolutely*. But taking domestic open grates suited to our existing fireplaces using what is called Wallsend coal, it is shown that some grates produce six times more smoke than others do, and burn three times more coal to do equal work.* The same report shows that steam boilers and other furnaces may be worked absolutely without smoke, and that the average of efficiency of steam boilers tested ranged between 30 per cent. and 76 per cent. of the coal consumed, and in the tests of different coals in the same furnace, the evaporative efficiences ranged between 6·84 and 12·25, or a variation of 55·7 per cent., thus proving the great necessity which

* Marked improvement has, however, been made in open grates and stoves for burning this description of coal, and one firm of manufacturers, who brought out a cheap stove at the South Kensington Exhibition, sent a report to the Council showing that they have sold upwards of 14,000 during the past two years ; and they remark that the public seem ready to burn non-smoky coal if proper stoves for using it are offered at a reasonable price.

exists for selection of coal as well as selection of furnaces.

Of the trades carried on in the metropolis in which at the present time smoke is being abated those trades which use steam boilers stand highest. The potters, iron founders, smiths, steam vessels and bakers, in individual cases, abate smoke entirely or keep it within very reasonable limits. And what individuals can do, the whole trade can do. But in general all these trades fall far short of what might fairly be done to stop smoke, which should no longer be called a nuisance but a national evil and a national disgrace.

The trades which appear by the Returns of Smoke Nuisances to produce the most smoke in the metropolis are the bakers, brewers, builders, chemical works, confectioners and pastry cooks, iron and brass founders, laundries, leather dressers, oilworks, potters, printers, sawmills, smiths, steam boats and tanners. Now in each of these classes, individual cases may be cited to show that trade can be carried on without any or with but little production of smoke. As evidence of this, a deputation recently waited upon us at a meeting of the Council of the Smoke Abatement Institution, and communications were received from various persons representing the following trades:—bread-bakers; japanning and lacquering; tile and porcelain firing; glass-staining and bending; carbon preparation for various purposes; furnace builders; confectioners; restaurant keepers and refreshment contractors; coke manufacturers; gas engine manufacturers; scientific instrument manufacturers, and others, to inform the Council that smoke-preventing appliances had been widely adopted with satisfactory results.

After the holding of the Smoke Abatement Exhibition, which has effected such useful results and furnished so much available information, the Committee took measures for creating an institution which would be fitted for carrying on the movement in an organised manner, and the present National Smoke Abatement Institution was established,

the deed of incorporation of which was signed by the Dukes of Northumberland and Westminster, Lord Mount Temple, Sir Lyon Playfair, Sir Frederick Pollock, Sir H. Hussey Vivian, and Mr. Ernest Hart on behalf of the Committee. The Institution was sanctioned by the Board of Trade in order to extend and carry on in a more organised manner the work previously carried on by the Smoke Abatement Committee of London and Manchester.

Last year's Report, which was submitted to a public meeting held at the Mansion House, included the result of the Council's enquiry into the working of the Smoke Acts in London, and the changes in heating methods which are gradually being introduced.

The results achieved are well summarised in the Report of the Committee presented at the Mansion House last week. It states that :—

In regard to the extended influence of the subject upon public opinion, it is to be noticed that in Manchester, Sheffield, Glasgow, Birmingham, Leeds, Preston, Salford Liverpool, and Newcastle, as well as numerous smaller places where the publications of the Institution have been freely circulated, the necessity for abating smoke has been generally recognised, and the subject is now one of active public discussion in the press and elsewhere. Strong appeals have been made to the local authorities to enforce the law, with successful results in many instances.

Medical opinion has been expressed with marked emphasis during the year, and fully bears out the view to which reference has already been made.

With regard to the changes in heating systems alluded to in the Council's Report submitted last year at the Mansion House, the Council are glad to be able now to announce that many of the changes referred to as being then only in prospect, or in a tentative state, have since become thoroughly established, with the most beneficial results,—notably the application of gaseous fuel to the heating of bakers' ovens. Since last year some of the largest bakeries have adopted the improved gas-heated

and other modified furnaces, and are now worked without producing any smoke whatever, and are turning out large quantities of bread prepared and baked under conditions which are more cleanly as well as more healthy to the operatives employed than were attainable when the old style of smoke-producing furnaces were used. Of this examples are exhibited in action in the working bakeries at the present Health Exhibition, which have been watched with much interest, and I hope profit, by vast numbers of people. This is one immediate outcome of the Smoke Abatement Exhibition of 1881.

It is stated that the number of gas engines in London had increased very rapidly within the past three years, and the total number now at work is estimated at upwards of 6,000, and thus a considerable quantity of smoke has been prevented by their use.

Several open domestic fire grates of modified form have been introduced into use during the past year, and the Council are glad to find that open grates now manufactured are generally improved by being shallower from front to back, and modified in the form of the bars and back, and by being lined with fire-brick, as well as in other points of detail, so as to render them more economical, and considerably less smoke producing. "Blowers," "radiators," and appliances of various patterns for ordinary open grates, have been introduced, and some of these have proved effective in reducing smoke and saving coal. While heating by open grates so largely prevails, any improvements in them must be considered particularly satisfactory. Corresponding improvements are observable in some of the modern forms of kitcheners. I may add that in my own house I have by a very cheap and simple modification of an old-fashioned large and unwieldy kitchener, on the principal of the Luton kitcheners of Messrs. Brown and Green, made it smoke-consuming with ordinary fuel, so that it is more efficient and economical in use. And for nearly two years the chimney has been smokeless, and during the whole of that time it has not

needed to be swept. My cook, too, is entirely satisfied with it.

Coke is now delivered by the chief gas companies broken into suitable size for burning alone or mixed with ordinary coal—a very important and economical means of heating with but little production of smoke. Fire-brick or other slow-conducting material is being increasingly used in modern grates instead of iron, and advancing knowledge has tended to considerably increase the use of coke for domestic purposes, under conditions compatible with free ventilation, and in no way adverse to health. Various simple arrangements of gas jets on the system introduced by the late Sir William Siemens for lighting coke, or urging the fire, when it requires to be suddenly increased, have been brought out recently, and have extended the use of these convenient and smokeless open fires.

The cooking apparatus for large as well as small establishments have been very materially improved. At the Draper's Hall, in the City, as well as at various other places in the Metropolis, kitchens entirely smokeless have been substituted for smoky ones; and in view of this fact the Council call the special attention of the authorities to the necessity for repressing smoke from the club-houses and hotels, restaurants, dining-rooms, and the like, which now needlessly produce it in very large quantities.

The improvements noticed last year in the manufacture of coke have been widely applied since, and various methods for recovering and utilising the volatile constituents of coal which are still largely dispersed into the atmosphere as constituents of "smoke" have been further perfected and applied. By one of these methods small coal, hitherto an entirely waste product in most districts, is converted into an excellent fuel for domestic purposes, which is cheap and entirely smokeless, while by-products are recovered, worth at present prices fully 2*s.* per ton of coal treated, after providing for the cost of the process.

An extensive series of tests of gas stoves and grates, gas boilers, gas regulators, and other gas appliances, have

been conducted for the Gas Committee of the recent Crystal Palace Exhibition, who retained the services of the Testing Engineer of the Smoke Abatement Institution, Mr. D. K. Clark, for the purpose, (see *Sanitary Record* for April 15, 1883). Awards have been made on the results of the tests by a jury of gas experts. The results of the experimental investigations led to many new and important deductions, considerably modifying, and in some respects reversing, generally received opinion. It was proved that under 20 per cent. of the heat generated in gas *cooking* stoves is directly utilised in roasting a joint, while, on the contrary, in gas-*heating* stoves of the best construction the proportion of heat utilised under favourable working conditions for heating the apartment reached upwards of 90 per cent. The report of these tests, which were of a complete and exhaustive character, is now in the press, and shows generally that marked improvements have been made, both in gas-cooking and gas-heating stoves, and that they must tend greatly to encourage the use of these stoves in preference to coal fires. Among the heating and smoke-abating apparatus now being exhibited at the present Health Exhibition, are many modifications of apparatus exhibited at South Kensington in 1881, and, as a member of the Executive Council of the present Exhibition, I am glad to be able to state that a valuable series of tests are now being made, in virtue of a grant of money which we have made for the purpose of defraying the expenses of such tests, under the direction of the Jury of the Exhibition, for the purpose of ascertaining the merits of new inventions, and the precise value of the changes which have been made, and in virtue of the arrangements made, the new series of tests will be uniform in character, and comparable with those attained at the previous exhibition. At my instance a decree was made at the outset of the Exhibition that the boilers needed for the production of motor power should be smokeless.

The Council of the Smoke Abatement Institute

consider the testing of new or modified apparatus as a most important and useful branch of the work of the Institution, and one of which they anticipate the public will further avail itself as time goes on. It is difficult for inventors and manufacturers to obtain satisfactory and impartial tests of their apparatus, and therefore they may be expected to avail themselves in increasing numbers of the facilities offered by the Institution; while on the other hand the public are at a disadvantage in judging of the character of modified systems, and the relative efficiency of new apparatus, in the absence of some system of independent tests. The stimulus given by competitive testing is very marked and beneficial. Even during the course of recent investigations, several cases of inventors modifying their apparatus and coming up for a second test have occurred, and, in the case of apparatus for using gas and coke for heating purposes, it may be mentioned that the newer forms of stoves are fully 20 per cent. superior in efficiency and economy to those of three years back.

Numerous lectures on cooking and heating, initiated by various persons interested in the smoke-abatement movement, have been given in various parts of London and the provinces, and at the Building Trades and Sanitary Exhibitions held in London, and in almost all the chief towns during the year, and it is particularly noticeable that heating and smoke-preventing apparatus has been shown as a separate and important branch of these Exhibitions.

The uses of smokeless coals and coke for heating purposes, both domestic and industrial, have increased considerably during the past year, and the system of heating houses uniformly by hot-water pipes has also increased as the direct result of the improvements made in the apparatus.

The use of producer-gas has much developed since the Smoke Abatement Exhibition, at South Kensington, and since that time it is satisfactory to find that many applications of gas-producers have been made in different

parts of the country, many leading firms have sent orders for additional producers after experience of their working. For boiler firing to char-kilns, for heating furnaces, annealing furnaces, brick, tile, and other furnaces, producer-gas has been successfully applied.

From the communications received from many places abroad, as well as from all parts of the United Kingdom, the Council express themselves satisfied that, on the one hand, the desire to abate the smoke of towns is fast increasing, and, on the other hand, the means of accomplishing that object have generally improved in kind and increased in variety.

During the year, the Council have arranged, as contemplated by their last Report, for heating and smoke-abating apparatus to be shown at the Parkes Museum. The collection will be added to, and changed from time to time, in order to be made as useful as possible to persons who have apparatus to bring into notice, and those who are in want of such articles. The Council hope the public will avail themselves of the facilities afforded by the Museum. No charge is made for exhibiting the articles, and the address of the exhibitor is attached to each.

A Bill to amend the Acts relating to smoke from the furnaces and fireplaces within the Metropolis has recently been introduced into the House of Lords by Lord Stratheden and Campbell. It contains provisions for the supervision and control of the heating arrangements of all *new buildings*, including dwelling-houses, in order that smoke from them may be minimised. The Bill further provides for local authorities being empowered to create, subject to the approval of the Home Secretary, bye-laws for the restraint of smoke in their respective districts, as well as to extend the provisions of the Smoke Abatement (Metropolis Acts) to the whole of the Metropolitan police area, and to include under the provisions of those Acts all the trades and furnaces which are not at present included.

It is stated in the last Report of the Smoke Abatement Institution, (see *Sanitary Record* for June 16, 1884), the

Council consider the progress made during the past year to have been in many respects satisfactory and encouraging. They, however, deem it essential that legislation should be advanced *pari passu* with the voluntary efforts which are being put forth. As regards London, it is obviously necessary that the area now covered by the Smoke Abatement Acts should be extended, that all the trades which do not at present come within the operation of the Acts should be included, and further, that the smoke of steamers on the river, which is now enormous and practically unchecked, should be brought under control, and the smoke from locomotive engines on the railways throughout the Metropolis should also be restrained. We shall all hope that these changes, as well as the regulation of the heating of new buildings, including dwelling houses, will receive the immediate attention of the legislature and the public.

Until the Smoke Abatement Committee was formed and a centre was established to which general interest in the subject could converge, the public were never adequately informed of the extent of the evil nor aroused to the necessity for concerted effort to abate it. No machinery by which the evil could be seriously grappled with had been provided, but in saying this, I do not disparage the efforts of those who have gone before, who are entitled to be considered as pioneers. They warned us against the evils of smoke, and even in some cases provided means for avoiding it to a great extent. The legislation which they initiated had the effect of reducing the smoke of certain districts, yet in spite of individual and isolated efforts, the excessive production of smoke has increased, growing with the growth of our cities, and the strides of our industrial progress. Self interest has, it must be borne in mind, done much within the last three or four years to check the evil, as was recently stated at Glasgow.

The future progress of the cause must depend mainly on the extent to which the public interest is awakened to recognition of the necessity and desirability of change, and on the choice of the time at which this influence is brought

to bear. If public support is prompt in encouraging and extending the movement now in active existence, scientific ingenuity and commercial interests will naturally be stimulated to continue efforts in an increasing ratio to supply public demand.

It is only by enlisting general public interest, now fairly awakened by the smoke-abatement movement, that present results have been attained, and we may now, without incurring the ridicule which at first attached to our efforts, reasonably indulge the hope of ultimate success in abolishing a smoke-laden atmosphere. I would quote the eloquent words of Sir Frederic Leighton, who said at the Mansion House, "If each individual would say, 'My fireplace shall smoke no longer,' the millenium would have come." The means exist and are accessible to all, and I am satisfied that London is now sensibly less smoky than when we began to work.

In conclusion, I may say that I do not believe that the Bill which has been brought in by Lord Stratheden and Campbell is destined to very serious consideration at present in Parliament, because it has been brought in under circumstances which, highly honourable as they are to the noble lord who has introduced the Bill, are not the circumstances under which an important measure of this sort ought to be brought in. It has not been brought in with the active aid of the leaders of any party, or with the assistance which we had a right to expect of the Home Office; and at the present time, valuable as is the proposed Bill for eliciting public opinion, I fear that it is powerless as regards legislation.* We must look to the leaders and people, to those who are in authority and power, not to allow a measure of this sort to be bandied about in the House as a measure in which they have no interest, in the manner in which the House is apt to deal with mere crotchets that can be delayed from year to year. We claim for the measure of Lord Stratheden and Campbell official recognition by

* Subsequent to the printing of these pages the Bill was read a second time.

the Government, and we claim for it a reference to a Select Committee or to a Royal Commission which shall impartially investigate the facts that we can place before the Committee. We have arrived at a stage when, as we say, great progress has been made and great possibilities are open, and we ask for an official investigation into the statements made—not alone by myself, but by a committee including the official adviser of the Government at the Royal Mint, the Lecturer on Metallurgy, and the great master of the science of combustion in this country, Professor Chandler Roberts, and on statements made by Mr. Kinnear Clark, and by Captain Douglas Galton, as well as by Dr. Frankland, and other high scientific authorities. All I have tried this evening to do, I know very imperfectly, but I hope earnestly, has been to promote a great public cause, which up to the present has been wholly carried on by private effort. We shall continue to carry the cause on though there are limits beyond which unaided private enterprise should not be solely relied upon. We believe that we have now reached that limit and that Government should step in to help us to solve this important question, and to give effect to the reforms which have been achieved.

A vote of thanks was accorded to Mr. Ernest Hart for his able lecture, and for his great services in initiating the Smoke Abatement movement and promoting its progress; and also to the Chairman for presiding.

APPENDIX I.

MORTALITY STATISTICS FOR LONDON AND FOUR GROUPS OF MANUFACTURING AND ONE OF RURAL DISTRICTS. 1880.

Groups of Districts.	Enumerated Population, 1881.	Deaths (All causes).	Deaths from Principal Zymotic Diseases.	Small-pox.	Measles.	Scarlet Fever.	Diph-theria.	Whooping Cough.	Fever.	Diarrhœal Diseases.	Deaths of Children under 1 year to 1000 births.
London	3,814,571	81,832	13,933	471	1521	3100	544	3516	910	3871	158
		21·5	3·65	0·12	0·40	0·81	0·14	0·92	0·24	1·02	
Aggregate of Groups I.–IV. .	2,784,169	60,920	11,209	27	1146	2136	205	1437	1374	4884	171
		21·9	4·03	0·01	0·41	0·77	0·07	0·52	0·49	1·76	
Group I. :—											
Wolstanton	179,762	4289	762	1	81	52	26	108	76	418	199
Stoke-on-Trent		23·9	4·24	0·00	0·45	0·29	0·14	0·60	0·42	2·34	
Group II. :—											
Wolverhampton	495,959	10,048	1786	..	134	387	35	243	187	800	162
Walsall											
West Bromwich											
Dudley		20·3	3·60	0·00	0·27	0·78	0·07	0·49	0·38	1·61	

Group III. :—											
Prescot	1,142,413	25,912 22·7	5417 4·74	23 0·02	592 0·52	1076 0·94	90 0·08	732 0·64	592 0·52	2312 2·02	174
Ormskirk											
Wigan											
Warrington.											
Leigh											
Bolton											
Bury.											
Blackburn											
Chorley											
Preston											
Group IV. :—											
Huddersfield	966,035	20,671 21·4	3244 3·36	3 0·00	339 0·35	621 0·64	54 0·06	354 0·37	519 0·54	1354 1·40	166
Halifax											
Bradford											
Hunslet											
Holbeck											
Bramley											
Leeds											
Group V. (Rural)											
Counties of Wilts, Dorset, and Devon, exclusive of Town Districts of Devizes, Salisbury, Weymouth, Exeter, and Plymouth.	804,764	14,226 17·7	1596 1·98	1 0·00	439 0·55	230 0·29	51 0·06	262 0·33	202 0·25	411 0·50	115

APPENDIX II.

MORTALITY STATISTICS FOR LONDON AND FOUR GROUPS OF MANUFACTURING AND ONE OF RURAL DISTRICTS. 1866 (CHOLERA YEAR).

Groups of Districts.	Estimated Population, 1866.	Deaths (All causes).	Deaths from Principal Zymotic Diseases.	Small-pox.	Measles.	Scarlet Fever.	Diphtheria.	Whooping Cough.	Fever.	Diarrhœal Diseases.	Deaths of Children under 1 year to 1000 births.
London	3,029,125	80,453	20,503	1391	2220	1892	462	2960	2688	8890	174
		26·6	6·77	0·46	0·73	0·62	0·15	0·98	0·89	2·94	
Aggregate of Groups I.–IV.	2,187,268	59,557	12,520	274	1768	1896	315	1975	2986	3306	195
		27·2	5·72	0·13	0·81	0·87	0·14	0·90	1·37	1·50	
Group I. :—											
Wolstanton, Stoke-on-Trent	141,929	4537	1101	88	105	293	66	96	194	259	215
		32·0	7·76	0·62	0·74	2·06	0·47	0·68	1·37	1·82	
Group II. :—											
Wolverhampton, Walsall, West Bromwich, Dudley	429,098	10,833	2226	5	245	294	65	566	521	530	187
		25·2	5·19	0·01	0·57	0·69	0·15	1·32	1·21	1·24	

Group III. :—											
Prescot, Ormskirk, Wigan, Warrington, Leigh, Bolton, Bury, Blackburn, Chorley, Preston	864,670	23,947 27·7	5554 6·42	115 0·13	744 0·86	1004 1·16	101 0·12	723 0·84	1234 1·43	1633 1·88	192
Group IV. :—											
Huddersfield, Halifax, Bradford, Hunslet, Holbeck, Bramley, Leeds	751,571	20,240 26·9	3639 4·84	66 0·09	674 0·90	305 0·41	83 0·11	590 0·79	1037 1·37	884 1·17	200
Group V. (Rural).											
Counties of Wilts, Dorset, and Devon, exclusive of Town Districts of Devizes, Salisbury, Weymouth, Exeter, and Plymouth.	799,543	15,927 19·9	2305 2·88	20 0·03	258 0·32	392 0·49	90 0·11	356 0·45	473 0·59	716 0·89	113

These tables may be read as follows:—

No. 1. *Mortality Statistics for London and Four Groups of Manufacturing and One of Rural Districts for* 1880.—London, with an enumerated population of 3,814,571, showed the deaths from all causes to be 81,832, being an average of 21·5. The deaths from the principal zymotic diseases were 13,933, being an average of 3·65; from small-pox, 471, an average of 0·12; from measles, 1,521, an average of 0·40; from scarlet fever, 3·100, an average of 0·81; from diphtheria, 544, an average of 0·14; from whooping-cough, 3,516, an average of 0·92; from fever, 910, an average of 0·24; from diarrhœal diseases, 3,871, an average of 1·02. The deaths of children under one year averaged 158 per 1,000 births.

The mortality of an aggregate of four groups of northern towns is, in the aggregate, as follows:—Out of an enumerated population of 2,784,169, the deaths from all causes were 60,920, being an average of 21·9 per 1,000. The deaths from the principal zymotic diseases were 11,209, being 4·03 per 1,000; from small-pox, 27, or 0·01 per 1,000; from measles, 1,146, being 0·41 per 1,000; from scarlet fever, 2,136, being 0·77 per 1,000; from diphtheria, 205, 0·07 per 1,000; from whooping-cough, 1,437, 0·52 per 1,000; from fever, 1,374, or 0·49 per 1,000; from diarrhœal diseases, 4,884, being 1·76 per 1,000. The deaths of children under one year amounted to 171 to each 1,000 births. An analysis of this aggregate of groups gives the following results:—

Group I., comprising Wolstanton and Stoke-on-Trent, with an enumerated population of 179,762, shows deaths from all causes 4,289, an average of 23·9 per 1,000; deaths from principal zymotic diseases, 762, average 4·24 per 1,000; measles, 81, or 0·45 per 1,000; scarlet fever, 52, 0·29 per 1,000; diphtheria, 26, or 0·14 per 1,000; whooping-cough, 108, or 0·60 per 1,000; fever, 76 cases, 0·42 per 1,000; diarrhœal diseases, 418, 2·34 per 1,000. Deaths of children under one year, 199 out of each 1,000 births.

Group II., comprising Wolverhampton, Walsall, West Bromwich, and Dudley, with an enumerated population of 495,959, shows deaths from all causes 10,048, being an average of 20·3 per 1,000; deaths from principal zymotic diseases, 1,786, average, 3·60 per 1,000; measles, 134, average, 0·27 per 1,000; scarlet fever, 387, average, 0·78 per 1,000; diphtheria, 35, average, 0·07 per 1,000; whooping-cough, 243, or 0·49 per 1,000; fever, 187, or 0·38 per 1,000; diarrhœal diseases, 800, or 1·61 per

1,000. Deaths of children under one year of age, 162 per 1,000 births.

Group III., comprising Prescot, Ormskirk, Wigan, Warrington, Leigh, Bolton, Bury, Blackburn, Chorley, and Preston, with an enumerated population of 1,142,413, shows deaths from all causes 25,912, average death-rate, 22·7 per 1,000; deaths from principal zymotic diseases, 5,417, average death-rate, 4·74; small-pox, 23, average death-rate, 0·02; measles, 592, average death-rate, 0·52 per 1,000; scarlet fever, 1,076, average death-rate, 0·94; diphtheria, 90, average death-rate, 0·08; whooping-cough, 732, average death-rate, 0·64; fever, 592, death-rate, 0·52 per 1,000; diarrhœal diseases, 2,312, average death-rate, 2·02. Deaths of children under one year, 174 to each 1,000 births.

Group IV., comprising Huddersfield, Halifax, Bradford, Hunslet, Holbeck, Bramley, and Leeds, with an enumerated population of 966,035, gives the following mortality returns:— Deaths from all causes, 22,671, with an average death-rate of 21·4; deaths from principal zymotic diseases, 3,244, with an average death-rate of 3·36; scarlet fever, 621, with an average death-rate of 0·64; diphtheria, 54, with an average death-rate of 0·06 per 1,000; whooping-cough, 354, with a death-rate of 0·37; fever, 519 deaths, being a death-rate of 0·54 per 1,000; diarrhœal diseases, 1,354, an average death-rate of 1·40 per 1,000. Deaths of children under one year, 166 per 1,000 births.

Next comes Group V., which is a rural group comprising the counties of Wilts, Dorset, and Devon, exclusive of town districts of Devizes, Salisbury, Weymouth, Exeter, and Plymouth, with an enumerated population of 804,764, and shows deaths from all causes 14,226, with an average death-rate of 17·7; deaths from principal zymotic diseases, 1,596, with an average death-rate of 1·98; measles, 439, an average death-rate of 0·55 per 1,000; scarlet fever, 230 deaths, or an average death-rate of 0·29; diphtheria, 51 deaths, average death-rate, 0·06; whooping-cough, 262 deaths, average death-rate, 0·33; fever, 202 deaths, average death-rate, 0·25 per 1,000; diarrhœal diseases, 411, average death-rate, 0·50 per 1,000. Deaths of children under one year of age, 115 per 1,000 births.

I have also the same figures made out for the cholera year of 1866, with the following result:—

No. 2. *Mortality Statistics for London, and Four Groups of Manufacturing and One of Rural Districts, during the Cholera Year of* 1866.—In London, with an estimated population for 1866 of

3,029,125, we find the deaths from all causes to be 80,453, an average death-rate of 26·6 per 1,000. The deaths from the principal zymotic diseases were 20,503, being an average rate of 6·77 per 1,000. Deaths from small-pox, 1,391, average rate, 0·46; measles, deaths, 2,220, death-rate per 1,000, 0·73; scarlet-fever, deaths, 1,892, rate per 1,000, 0·62; diphtheria, 462 deaths, death-rate per 1,000, 0·10; whooping-cough, deaths, 2,960, death-rate per 1,000, 0·98; fever, 2,688, death-rate, 0·89 per 1,000; diarrhœal diseases, 8,890, death-rate per 1,000, 2·94. Deaths of children under one year, 174 to each 1,000 births. We then have an aggregate of the mortality of the same manufacturing districts as in the set of tables No. 1. The aggregate of the estimated population in these four groups was 2,187,268; the deaths from all causes, 59,557, with a death-rate of 27·2 per 1,000. The deaths from the principal zymotic diseases in this group of four districts amounted to 12,250, the death-rate being 5·72 per 1,000; the deaths from small-pox were 274, the death-rate 0·13 per 1,000; from measles the deaths were 1,768, death-rate 0·81 per 1,000; scarlet-fever reckoned 1,896, with an average death-rate of 0·87 per 1,000; diphtheria reckons 315 deaths, with a death-rate of 0·14 per 1,000; whooping-cough, 1,975 deaths, death-rate 0·90 per 1,000; fever, 2,986 deaths, death-rate 1·37 per 1,000; diarrhœal diseases, 3,306, death-rate 1·50 per 1,000. Deaths of children under one year, 195 deaths per 1,000 births. An analysis of these groups gives the following results :—

Group I., comprehending Wolstanton and Stoke-upon-Trent, with an estimated population of 141,929, gives 4,537 deaths from all causes, or a death-rate of 32·0 per 1,000. Deaths from principal zymotic diseases were 1,101, a death-rate of 7·76; from small-pox, 88, a death-rate of 0·62; from measles, 105, a death-rate of 0·74; scarlet fever, 293, a death-rate of 2·06; diphtheria, 66 cases, an average death-rate of 0·47; whooping-cough, 96, average death-rate, 0·68; fever, deaths, 194, death-rate, 1·37; diarrhœal diseases, 259 deaths, average death-rate, 1·82. Deaths of children under one year, 215 deaths per 1,000 births.

Group II., comprising Wolverhampton, Walsall, West Bromwich, and Dudley, of which the estimated population is 429,098; the deaths from all causes 10,833, average death-rate, 25·2 per 1,000. Deaths from all principal zymotic diseases, 2,226, average death-rate, 5·19; measles, deaths, 245, average death-rate, 0·57; scarlet-fever, 294, death-rate, 0·69; diphtheria, 65, death-rate,

0·15; whooping-cough, deaths, 566, death-rate, 1·32; fever, deaths, 521, death-rate, 1·21; diarrhœal diseases, deaths, 530, death-rate, 1·24. Deaths of children under one year, 187 deaths to every 1,000 births.

Group III., comprising Prescot, Ormskirk, Wigan, Warrington, Leigh, Bolton, Bury, Blackburn, Chorley, and Preston, with an estimated population of 864,670, affords statistics giving deaths from all causes, 23,947, a death-rate of 27·7 per 1,000. Deaths from principal zymotic diseases, 5,554, with a death-rate of 6·42; small-pox, 115 cases, death-rate, 0·13; measles, deaths, 744, death-rate, 0·86; scarlet-fever, deaths, 1,004, death-rate, 1·16; diphtheria, 101 deaths, death-rate, 0·12; whooping-cough, 723 deaths, death-rate, 0·84; fever, 1,234 deaths, death-rate, 1·43; diarrhœal diseases, 1,633, death-rate, 1·88. Deaths of children under one year, 192 per 1,000 births.

Group IV., comprising Huddersfield, Halifax, Bradford, Hunslet, Holbeck, Bramley, and Leeds, with an estimated population of 751,571, gives in this cholera year of 1866, registered deaths from all causes, 20,240, with a death-rate of 26·9 per 1,000. Deaths from principal zymotic diseases, 3,639, death-rate, 4·84; small-pox, 66 deaths, death-rate, 0·09; measles, 674 deaths, death-rate, 0·90; scarlet-fever, deaths, 305, death-rate, 0·41; diphtheria, 83 deaths, death-rate, 0·11; whooping-cough, deaths, 590, death-rate, 0·79; fever, 1,037 deaths, death-rate, 1·37; and diarrhœal diseases, deaths, 884, death-rate, 1·17. The deaths of children under one year of age amounted to 200 per 1,000 births.

Group V., which comprises the rural counties of Wilts, Dorset, and Devon, exclusive of the town districts of Devizes, Salisbury, Weymouth, Exeter, and Plymouth, with an estimated population of 799,543, shows deaths from all causes, 15,927, death-rate, 19·9; deaths from principal zymotic diseases, 2,305, average death-rate, 2·88; small-pox, deaths, 20, death-rate, 0·03; measles, 258, death-rate, 0·32; scarlet-fever, 392 cases, death-rate, 0·49; diphtheria, deaths, 90, death-rate, 0·11; whooping-cough, 356 deaths, death-rate, 0·45; fever, 473 deaths, death-rate, 0·59; diarrhœal diseases, 716 deaths, death-rate, 0·89. The deaths of children under one year of age was 113 to every 1,000 births.

APPENDIX III.

SMOKE NUISANCE ABATEMENT (METROPOLIS). [H.L.]

47 & 48 Vict.

A Bill intituled An Act to amend the Acts for abating the Nuisance arising from the Smoke of Furnaces and Fireplaces within the Metropolis.

Whereas by an Act passed in the Session of Parliament held in the sixteenth and seventeenth years of the reign of Her present Majesty, intituled "An Act to abate the Nuisance arising from the Smoke of Furnaces in the Metropolis and from Steam Vessels above London Bridge" (16 & 17 Vict. c. 128) (in this Act referred to as "the Act of 1853"), and by a further Act passed in the session of Parliament held in the nineteenth and twentieth years of the reign of Her present Majesty, intituled "An Act to amend the Smoke Nuisance Abatement (Metropolis) Act, 1853" (19 & 20 Vict. c. 107) (in this Act referred to as "the Act of 1856"), and by the Sanitary Act, 1866 (29 & 30 Vict. c. 90), provisions have from time to time been made for abating the nuisance arising from the smoke of furnaces and fireplaces within the metropolis, but the said provisions have not been effectual in abating the same; and it is expedient that further provision should be made in relation thereto:

Be it therefore enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows; that is to say,

1. *Short Title.*—This Act may be cited for all purposes as the Smoke Nuisance Abatement (Metropolis) Act, 1884.

2. *Limits of Act.*—This Act shall extend and apply to the

metropolis as defined by the Metropolis Management Act, 1855 (18 & 19 Vict. c. 120).

3. *Interpretation.*—In this Act—

The expression "local authority" means,

As to the city of London and the liberties thereof, the mayor, commonalty, and citizens acting by the Commissioners of Sewers;

As to any parish mentioned in Schedule A. to the Metropolis Management Act, 1855, the vestry;

As to any district mentioned in Schedule B. to the Metropolis Management Act, 1855, the district board; and

The expression "district," used in relation to any local authority, means the area within which such local authority has jurisdiction.

4. *Power for local authorities to make byelaws prohibiting emission of smoke from buildings.*—Any local authority may from time to time make, and when made, alter and repeal byelaws—

For prohibiting or regulating the emission of smoke from any building within their district.

Any such byelaws may exempt buildings below a certain rateable value to be fixed by such byelaws from the operation thereof, or may limit the hours within which such byelaws are to be in force, or may contain any other restrictions and provisions which the local authority may think expedient.

Any local authority may, by any byelaws made by them under this section, impose on offenders against the same such reasonable penalties as they think fit for each offence, and in the case of a continuing offence such further penalty as they think fit for each day after written notice of the offence from the local authority; but all such byelaws imposing any penalty shall be so framed as to allow of the recovery of any sum less than the full amount of the penalty.

No byelaw made in pursuance of this section, or alteration, or repeal thereof, shall be of any validity until it has been confirmed by one of Her Majesty's principal Secretaries of State.

No byelaw made under this section, or alteration or repeal thereof, shall be confirmed by one of Her Majesty's Principal Secretaries of State until the expiration of two months after a copy of the byelaw, together with notice of the intention to apply for confirmation of the same has been published by the local authority, once at least in each of two consecutive weeks in two or more newspapers circulating in the metropolis; and any

erson affected by any such proposed byelaw, or alteration or repeal thereof, may forward notice of his objection to such Secretary of State, who shall take the same into consideration.

All byelaws made and confirmed as aforesaid in pursuance of this section shall be printed and hung up in the principal office of the local authority and be open to public inspection without payment, and copies thereof shall be delivered to any person applying for the same on payment of such sum, not exceeding twopence, as the local authority shall direct; and such byelaws when so published shall be binding upon and be observed by all parties, and shall be sufficient to justify all parties acting under the same, and the production of a printed copy of such byelaws authenticated by the seal of the local authority shall be evidence of the existence and of the due making, confirmation, and publication of such byelaws in all prosecutions under the same without adducing proof of such seal, or of the fact of such confirmation or publication of such byelaws.

Penalties imposed by any such byelaws may be recovered summarily, but no proceedings for the recovery thereof shall be had or taken by any body or person other than the local authority of the district without the consent in writing of the Attorney-General.

5. *Power for Metropolitan Board of Works to make bye-laws as to fireplaces, &c., in new buildings.*—The Metropolitan Board of Works may from time to time make, and when made alter and repeal byelaws. For requiring any fireplace or furnace intended to be used in any building to be constructed after the passing of this Act to be so constructed as to effectually consume or burn, so far as possible, all smoke arising therefrom, and all the provisions of section sixteen of the Metropolis Management and Building Acts Amendment Act, 1878, as to the making, contents, confirmation, publication, evidence, enforcement, alteration, and repeal of byelaws made under that Act, and otherwise in relation thereto, shall extend and apply to byelaws made, altered, or repealed under this section, and have effect accordingly.

6. *Amendment of the Acts of* 1853 *and* 1856.—From and after the passing of this Act section six of the Act of 1853 shall be and the same is hereby repealed, and the said Act and the Act of 1856 shall be read and construed as though the expression "metropolis" in the said Acts meant the metropolis as defined by the Metropolis Management Act, 1855, together with the parish of Willesden.

7. *Amendment of s.* 19 *of Sanitary Act,* 1866.—From and after the passing of this Act section nineteen, sub-section three, of the Sanitary Act, 1866, shall be read and construed as though the words "not being the chimney of a private dwelling house" had been omitted therefrom, and the said words shall be and the same are hereby repealed.

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