New, expert information
of vital current importance!

Problems and Control of AIR-POLLUTION

Edited by

FREDERICK S. MALLETTE

Executive Secretary, Committee on Air-Pollution Control,
The American Society of Mechanical Engineers

REINHOLD
PUBLISHING
CORPORATION

PROBLEMS AND CONTROL
OF
AIR POLLUTION

Proceedings of the First International Congress on Air Pollution held in New York City, March 1–2, 1955 under the sponsorship of the Committee on Air-Pollution Controls of The American Society of Mechanical Engineers.

Edited by

FREDERICK S. MALLETTE

Executive Secretary
Committee on Air-Pollution Controls
The American Society of Mechanical Engineers

REINHOLD PUBLISHING CORPORATION
NEW YORK

CHAPMAN & HALL, LTD., LONDON
1955

Library of Congress Catalog Card Number: 55-11271

REINHOLD PUBLISHING CORPORATION
Publishers of Chemical Engineering Catalog, Chemical Materials Catalog, "Automatic Control," "Materials & Methods"; Advertising Management of the American Chemical Society

PRINTED IN THE USA BY
WAVERLY PRESS

PREFACE

In the past ten years, but particularly since 1948 with its attendant Donora smog, air-pollution control has developed with increasing rapidity. Stimulated further by the London smog of 1952—one of the greatest of modern catastrophes—and by the recurrent smog problem in the Los Angeles basin, the pace has continually quickened. Research, legislation, field studies, control developments, and, particularly, the need for competent personnel have all increased tremendously.

In recognition of this broadened and accelerating force, The American Society of Mechanical Engineers in 1949 organized its Committee on Air-Pollution Controls. This activity stemmed from earlier work culminating in the publication of the "Example Sections for a Smoke Regulation Ordinance" which has been adopted in total or in part by most of the municipalities in the United States.

Among its many activities is the sponsorship, by the committee, of symposia on the abatement of air pollution. The committee organized and sponsored the First International Congress on Air Pollution as one of the feature events celebrating the 75th Anniversary of The American Society of Mechanical Engineers. The papers presented at that meeting comprise this book.

Distinguished air-pollution experts from six foreign countries, as well as many from the United States, participated. The outstanding event was the presentation of the Calvin W. Rice Lecture by Sir Hugh E. C. Beaver, chairman of the Government Committee on Enquiry into the Nature, Causes and Effects of Air Pollution, who presented a masterly summary of the British smog problem and the remedies proposed.

Another feature was the illuminating discussion of the public relations aspects of air pollution by G. Edward Pendray, an outstanding counsel in this field. The Beaver and Pendray addresses occupy the leading chapters of this book.

For the technical sessions, every effort was made to obtain new and original material by recognized authorities. This is particularly true of the chapters on the treatment and recovery of sulfur dioxide for in this gas, it is believed, lies a formidable challenge to practicable and effective control.

The opinions expressed are those of the authors and do not necessarily reflect those of the committee nor of The American Society of Mechanical Engineers.

FREDERICK S. MALLETTE

New York
July 15, 1955

CONTENTS

EXPERIENCE IN AIR POLLUTION ABROAD

1. THE GROWTH OF PUBLIC OPINION

Sir Hugh E. C. Beaver

Chairman of the Government Committee of Enquiry into the Nature, Causes and Effects of Air Pollution
Managing Director, Arthur Guinness Son & Company, Ltd.
Park Royal Brewery, London, England

INTRODUCTION

In the clamor of international politics, under the shadow of an ever-accelerating arms race, with the prospects, hopes and threats of increasingly spectacular and almost incredible scientific discoveries demanding more and more of our attention and almost usurping all our thoughts, we are not to forget that human beings still live and breathe in this world. Breathe—but what do they breathe? For countless millions it certainly no longer is, or for many years has been, pure air.

AIR POLLUTION—PROBLEM OF LONG STANDING

The story of air pollution, or rather the campaign against it, goes back into history much farther than I am aware; but in England the record covers some 700 years. For most of this time it has been smoke and soot—coal smoke—that has drawn criticism and attack. Both criticism and attack have been violent enough, and I think one may well feel surprized how, generation after generation, the evil has been described in such scathing terms and the practicability of effective action so repeatedly demonstrated —and yet nothing, or almost nothing, has been accomplished.

When I first became chairman of the latest of the committees on this subject in England, I soon came to the conclusion that in all probability there was little new to be said; that thirty or fifty or indeed a hundred years before, the same criticisms and the same or similar recommendations had been made. It could have been disheartening to read the concluding paragraphs of the previous committee which, reporting 33 years ago, complained, "No Government has for many years taken any action with the exception of appointing committees whose labours have led to little or no result."

But all action to be successful needs to be successfully timed, and it may well be—it seems to me—that conditions are now ready in England, or at least much more ready than ever before, for really drastic action. That is why it has seemed worth while to devote this discussion to a brief study of the growth of public opinion, for experience has shown that on public opinion, and on it alone, finally rests the issue. As one of the speakers at the U. S. Technical Conference on Air Pollution in 1950 said, "If enough delegations of irate citizens protest, air-pollution-control legislation can be enacted." Good legislation itself will be ineffective unless public opinion supports its enforcement.

As I have already mentioned, there is almost nothing new to be said on the subject of smoke and grime, and their prevention. The amount of material that has already been published, the speeches that have been delivered, the propaganda published, the demonstrations of remedies given, are legion and almost overwhelming. I speak with some feeling, having attempted in this last year to make the most cursory study of it all. This means that I am treading a rather worn path, particularly historically; but to study the growth of opinion I must sketch the high lights of the story over the centuries in England.

SEVEN HUNDRED YEARS OF INACTION

We must flit quickly over the first few centuries; I do not want to disregard them completely because of their human interest. It strikes a sympathetic chord, I think, to learn that 700 years ago almost to a year the then Queen of England moved out of the city to Nottingham where she was residing because of the insufferable smoke; and that some 300 years later the brewers of Westminster offered to use wood instead of coal because of Queen Elizabeth's allergy to coal smoke. But it was only about the end of her reign that feeling began to lead to action; and then there was a prohibition—probably ineffective—of the use of coal in London while Parliament was sitting!

At that time, however, the real cure was partly envisaged, and a Welshman, one Thomas Owen, introduced the very low-volatile coals and anthracites of South Wales to London, while an enterprising knight produced some smokeless briquettes, in which he claimed to have "charred" out the sulfur. Halfway through the next century the citizens of London unavailingly petitioned Parliament against any importation of "sea" coals from Newcastle; and John Evelyn the Diarist produced his famous pamphlet, *Fumifugium*, in which he advocated the cure of the London smoke nuisance by moving all the smoke-producing plants out of London. His plea had no effect, but that sort of local, shortsighted policy, namely, of curing one's own ill by moving the offenders from one area into another lasted a long

time. As the years went on there was sporadic individual agitation. Though the individuals seem largely to have been riding their own hobby horses, yet certainly in the eighteenth century it was appreciated and often emphasized that the trouble of smoke was due to the inefficient use of coal.

FIRST "SMOAK" NUISANCE COMMITTEE

I do not think one can say that there was any real beginning of public interest until the very end of that century. By 1801, the corporation of Manchester actually had a Nuisance Committee dealing with "smoak." By 1819, there was sufficient pressure for Parliament to appoint the first of a whole dynasty of committees "to consider how far persons using steam engines and furnaces could work them in a manner less prejudicial to public health and comfort." This committee confirmed the practicability of smoke prevention, as so many succeeding committees were to do, but as was often again to be experienced, nothing was done.

In 1843, there was another Parliamentary Select Committee, and in 1845, a third. In that same year, during the height of the great railway boom, an act of Parliament disposed once and for all (!) of trouble from locomotives by laying down the dictum that they must consume their own smoke. The Town Improvement Clauses Act two years later applied the same panacea to factory furnaces. Then 1853 and 1856 witnessed two acts of Parliament dealing specifically with London and empowering the police to enforce provisions against smoke from furnaces, public baths, and washhouses and furnaces used in the working of steam vessels on the Thames. In 1855 the General Board of Health published an official review of the smoke problem and of the efforts to abate it.

In resorting to the police, Parliament and London followed a trail that had long since been blazed by Manchester and Salford. In 1840, the Manchester Police Commissioners had appointed a Nuisance Committee to carry out the police regulations "relating to the height of chimneys, for the purpose of preventing nuisances arising from smoke and . . . to take any steps which may be necessary for compelling owners and occupiers of steam engines and fire engines to construct the fireplaces and chimneys thereof respectively in such a manner as most effectively to consume and destroy the smoke arising therefrom." In 1844, a Manchester Borough Police Act dealt with furnaces, etc., and both Manchester and Salford were by then employing police constables as smoke inspectors.

THE NINETEENTH-CENTURY APPROACH

It is necessary to telescope this historical survey, just mentioning the Public Health Acts of 1866 and 1875, and continue to the 80's. The Smoke

Abatement Committee was formed and staged an exhibition in London; The Manchester Vapours Association had an exhibition the next year. This surge of activity culminated in the introduction into the House of Lords of a Smoke Abatement Bill on behalf of London, but this too got nowhere.

The next development came at the end of the century, when the Coal Smoke Abatement Society was formed with headquarters at London. The Leeds Smoke Abatement Society was also active at this time; the Birmingham Corporation and the London County Council became active and Sheffield and Glasgow followed a few years later. Sheffield staged the usual exhibition, and there were a few more local societies formed. Finally, the combined agitation of these various local authorities led to the introduction into Parliament of a Bill at the end of 1913. The Bill was withdrawn on a promise by the Government to appoint a committee; and another committee was duly appointed. By this time however World War I was upon us and though the committee had just met, it immediately went into abeyance.

In reading the history of this century of agitation and concern, one is struck mainly by the disjointed and ephemeral nature of the activities. Enthusiastic individuals caused commotion locally; societies, associations, and committees were formed, flourished for a short while, and disappeared; papers were read and exhibitions held. But there was little united effort and all too little real interest by local authorities. It was still the "laissez faire" age; the conscience of comparatively few people had yet been stirred; nothing must interfere with industrial prosperity.

THE 1914 GOVERNMENT COMMITTEE REPORTS IN 1921

In 1920, the Government Committee of 1914 was revived, under the chairmanship of Lord Newton. Its final report was published in December 1921. I will quote just a few sentences from its general conclusions.

"We think that by this time it should be regarded as an axiom that an impure atmosphere is highly deleterious to health and property, that it is indicative of wasted fuel and energy, and that every practicable step should be taken to prevent it.

"The prevalence of smoke pollution in this country is mainly due to the indiscriminate and wasteful use of raw coal for all purposes, whether industrial or domestic, and to the lax administration of the law by the responsible authorities. It is clear that there is no bold and simple remedy which might appeal to the imagination and excite the enthusiasm of the general public. The proposals which we have put forward are of a prosaic but practical character . . . the chief requisite is the enforcement of the provisions of the existing law, strengthened and altered as to its administration in accordance with the recommendations which we have put forward.

"We have been struck by the fact that, more especially in the large cities, there is a strong body of educated opinion which is extremely dissatisfied with present conditions, and would welcome more drastic action. On the other hand it is an undoubted fact that the great majority of the public have never given any thought to the question of smoke prevention. Residents in industrial districts who have grown up and passed their lives in surroundings which occasionally appear to be almost intolerable, are found to acquiesce in a state of things which they believe to be unavoidable. . . . This attitude of indifference is reflected in the apathy of the great majority of local authorities throughout the country, who as we point out have failed to do their duty.

"Perhaps the chief factor in the failure to deal with the smoke evil has been the inaction of the Central Authority. . . . Smoke and air pollution are in our opinion a national question and we consider that it is useless to expect that it will be adequately dealt with by local authorities unless they are subject, when necessary, to the stimulus of Government.

"In the course of our investigation we have never ceased to bear in mind that the interests of trade must be fully considered, and that the introduction of legislation which might prejudicially affect important industries is quite out of the question."

The report created very little interest; but it should be remembered that we were then in a precarious situation economically; it was a period of political struggle; the whole of our industrial prosperity was threatened, and indeed the long period of disastrous slump and unemployment was about to start. Under the circumstances action was neither likely nor perhaps possible. Even so the total absence of general interest is notable.

Perhaps two quotations from the leading article of the *Times* on the subject will best illustrate the attitude that still persisted: "The final report of Lord Newton's Committee on Smoke and Noxious Vapours Abatement is a sane and convincing presentment of a complex problem, the more weighty because it suggests no heroic measure. . . . We read with relief that the Committee does not propose to saddle industries with the burden of attaining immediate perfection, but insists that cost shall be one of the operating factors in deciding what is practicable." In other words one need not fear that anything very inconvenient or disturbing would result from the report—and little did, until 1936, when a new Public Health Act was passed, of which one part specifically dealt with air pollution.

This is still the prevailing law—an act, in so far as air pollution is concerned, full of loopholes, reservations, and safeguards and more or less licensed default. The view of my Committee regarding this act is given in a sentence: "It is apparent from the conditions which prevail today that the law has failed to achieve its purpose, notwithstanding that it has been in

operation for many years, and that considerable progress has been made in the technique of smoke prevention."

But the campaign continued. One cannot say that it greatly increased in strength, although some advance was undoubtedly made. The National Smoke Abatement Society was formed out of the two principal local societies, and for the first time agitation, propaganda and public education were put on a national basis. Manchester, always in the lead, invented and secured parliamentary powers for the new idea of smokeless zones (these will be referred to later).

Before much could be done, World War II came upon us, and for a time all the industrial plants were actually encouraged to make as much smoke as possible as a protection against accurate bombing. After the war we fell back into the old pattern—with some local authorities active. Owing to our worsening fuel situation, increasing emphasis was laid on the fact that smoke meant waste of our diminishing coal resources.

THE 1952 DISASTER

And then, in December 1952, occurred what has become universally known as the London Smog—in its way I imagine the most disastrous, the most lethal occurrence of air pollution that has yet been recorded. We have always had heavily polluted fogs in London and in some of our other industrial cities. They are seasonal; frost and still air inevitably produce them. Each winter, from November to February, some generally pretty bad fogs or smogs are certain. But between December 5 and 9, 1952, there was a smog in London which caused some 4000 deaths.

It was only slowly that the extent of the calamity dawned on either medical authorities or the Government, or the public. It was not until December 18 that the Minister of Health was able to give reliable although still incomplete figures. At once there was an outcry. The papers, with hardly an exception, demanded an inquiry. People were unquestionably, and for the first time, frightened, and even a year later when winter fogs again appeared many started to wear masks. There was little doubt that the Government was completely undecided how to cope with the matter, and for six months nothing was done. Naturally, the main clamor in the press quickly died down, but from time to time the matter was revived by one paper or another, while pressure from many individuals continued steadily.

THE PRESS CALLS FOR ACTION

The committee—which, as so often before, was the answer—and over which I presided, was appointed in July, 1953. This is the beginning of our holiday season, and the committee was unable to meet as a whole until

September. By October there was renewed clamor in the press for action, and the blame, naturally, fell on the committee. From the outset we had decided to issue an interim report, designed to set forth the known facts. We thought that this was desirable, in order that, when it came time to write the final report, it would not be cluttered up with a whole lot of descriptive material which would distract attention from the findings and recommendations. This interim report, which appeared early in November, was received with derision by most of the popular press, but anything was better than an absence of interest.

FINAL REPORT

A year later, in November, 1954, the final report was published. It came out at the beginning of the foggy season, and it was received with a most remarkable chorus of approval and a general call for action. This reception cannot be claimed to be the result of anything of special note in the report itself. The report was received, as it was, I believe, simply or mainly because the atmosphere of public opinion at the moment was peculiarly suitable and receptive for the right kind of a report. We on the committee cannot claim credit for any mastery of timing; but perhaps we can claim to have recognized the time for it.

Let me explain what I mean, and to that end let me summarize the committee's approach and conclusions. Although, as I have admitted, there was little really new in the problem, and although what we said had generally been said before, and what we advocated had largely been advocated before, yet there were some points on which stronger emphasis was laid—and perhaps a clearer picture painted, than most people had seen before.

We particularly aimed at being clear and emphatic in expressing our views and in defining our recommendations. We were aware that the report was going to be, and ought to be, read by the average newspaper reader, either directly or much more generally by extracts in the press. We wrote so that the reader, that is to say the general house holder, the ordinary businessman or professional man, or the housewife, could easily understand and grasp what we proposed and why. We certainly had enough material to produce a long, detailed and scientific study, and we had to consider and weigh this vast volume of material. We finally produced our conclusions in some 12,000 words.

Again we adopted a perhaps unusual technique in regard to getting evidence and collecting the facts. We took no formal evidence. We started with the premise that all persons and all parties were agreed as to the objective, namely, the cure of air pollution, and that the only questions for discussion therefore were the practicability and the means. We invited in

turn all interests to a sort of round-table discussion of a joint problem, and we divided the committee into a number of small subcommittees to carry on the subsequent discussions quite informally. We believed—and the event confirmed our belief—that circumstances justified such an approach and that far better results would be secured.

Whereas the Newton committee in 1921, to which I have already referred, produced a final report of about the same length as ours, it was accompanied by some 850,000 words of printed formal evidence of the typical question and answer type. I am not for a moment criticizing that committee. Under the then-existing conditions it was probably the only and certainly the expected method. But it would have been a serious error of judgment on our part not to recognize that a changed climate of opinion permitted and justified a change of method.

WHAT THE REPORT COVERED

Considering that the presentation of the case was as important as the case itself, we started our report with a clear statement of the two counts against air pollution—health and cost. We expressly avoided basing our arguments on the danger to health of particular incidents, such as the London Smog of 1952. Not that we minimized that catastrophe in any way, but we felt that undue emphasis would distract attention from the fact that damage to health and danger to life were constantly going on all over the country, year in and year out. It was inevitably a black and disquieting picture; a sad bill of unhappiness and ill health and earlier death for which the whole country was paying. And then we gave our considered estimate—and I think we went deeper into this problem than had previously been done—of the economic cost to the nation.

Over and above the burden of ill-health, the country was spending, directly or indirectly because of air pollution, something like five pounds, say fifteen dollars, per person per year. This was, we believed, a conservative estimate. It was against this whole background that we then proceeded to make our recommendations. I suppose someone might feel that we could have been more scientific in our presentation of the case. I would claim that we were absolutely judicial, but when it came to sentence we were the hanging judge; and after all we were dealing with human beings and their living conditions.

And now what did we propose? I will discuss only the key points—many of which, as I must emphasize once again, had often been made before, but where I think we changed the emphasis somewhat. First, I must explain that England, Scotland and Wales comprise in all some 88,000 square miles and have a population of about 51,000,000 persons. If you eliminate the northern and far western parts of Scotland, the hills of Wales and the ex-

treme southwest of Devon and Cornwall, you have an area of say 60,000 square miles in which almost the whole of the population lives—say the area of Michigan with eight times its population. Large parts of this area are highly industrialized and obviously very densely populated. Except in the south no part was more than about 100 miles wide, and often not that. There are in this area some 14,000,000 houses, most of which have open fireplaces and some hundred thousand factory chimneys. If one included all of the small furnaces which together may consume some 10 to 15 million tons of fuel a year, the total number of chimneys would be at least twice as great and possibly more. Add to this the fact that pollution from factory chimneys and domestic grates has been measured 60 miles and more from its source and you have some idea of the problem in one single permanently polluted area.

My committee moreover estimated that more than half the population lived in highly industrialized and heavily populated areas that were by geographical location subject to frequent and persistent natural fog throughout the autumn months and consequently subject to frequent concentrated severe smog. We called these the "black areas," and decided that attention must be directed to these plague spots. These conditions are so different from those in the United States that it may not be easy for you to realize how such a position both required and permitted that the problem be treated as a whole and as a national problem. We had no doubt that this was so—though leaving generally with the local authorities the responsibility for enforcing the great part of the legislation.

PROPOSALS

First, we proposed that all previous legislation, national and local, should be included in a new all-embracing act applicable to the whole country. We proposed that this new act should be called the Clean Air Act, a simple but, as I feel, brilliant and pregnant suggestion that came to us from our subcommittee dealing with legislation over which Sir Roger Duncalfe, also the Deputy Chairman of the main committee, presided.

We proposed that legislation regarding industry should be nation-wide and that there should be no question of pushing or removing potential industrial nuisances out of one local boundary into another. This is a much easier course to take in a small and more or less homogeneous country like Britain than it would be in the United States but the differing attitudes, fears and jealousies of different and neighboring local authorities (of which there are over 1500) had in the past seriously restricted action in regard to serious and avoidable nuisances.

We proposed that in so far as all ordinary furnaces were concerned dark smoke was prohibited and that it should no longer be necessary to prove

that it was a nuisance. We proposed that there should be no "protected" or sheltered industries or processes; that all without exception should be subject to challenge by really qualified national inspectors.

We proposed to create a simple way of establishing smokeless zones, instead of each local authority having to secure parliamentary power for itself.

We invented a new type of semi-smokeless zone where smoke was to be reduced by 80 per cent. This included a large amount of industrialized area, which could not be fitted into any smokeless zone. Perhaps I should describe what is meant by "smokeless zones" and new "smoke-control" areas. A smokeless zone was an idea first put forward in Manchester in 1935. The first smokeless zone came into existence in 1951. Nineteen cities now have the necessary powers, and six have actually established smokeless zones. The relevant part of a typical smokeless-zone clause is as follows:

(1) The Corporation may by order confirmed by the Minister of Housing and Local Government prohibit the emission of smoke from premises to which the order applies.

(2) The occupier of any premises from which smoke is emitted in contravention of the provisions of an order under this section shall be liable to a penalty not exceeding ten pounds and to a daily penalty not exceeding five pounds.

Provided that it shall be a defense in any proceedings under this subsection to prove that the smoke emitted:

(a) Arose solely from a furnace stove or other appliance suitable for burning an authorized fuel and properly maintained and used; and

(b) So arose either (i) by burning that authorized fuel therein; or (ii) by burning any other type of fuel therein unless it is proved by the prosecutor that the authorized fuel was available to the defendant at the time the smoke was emitted.

In this subsection the expression "authorized fuel" means coke anthracite or any other fuel specified in the order as being an authorized fuel for the time being approved by the corporation.

It aims, as will be seen, at absolute smokelessness; and since low-volatile coals in England are scarce, gas and electrical heating costly, and all oil is imported, it is obvious that even the utmost practical development of smokeless zones could only solve a small part of the smoke problem. We therefore devised this type of area, which we called "smoke-control areas," where we aimed at an 80 per cent over-all reduction of the total smoke. This would be within the reach of all industrial plants, except those of special and particularly difficult processes. By this means, effective smoke reduction would be secured over a very large part of the industrial and populated areas. Under our proposals, all local authorities would be given

legal powers subject to ministerial approval, to establish smokeless and smoke-control zones.

We proposed that part of the costs that would fall on individuals and businesses should properly be defrayed from the national purse.

We proposed that every local authority would have to publish an annual account of its activities in the past year in dealing with air pollution.

Finally we proposed that there should be established a Clean Air Council to watch, to encourage, to coordinate all activities and all aspects, and to report annually to Parliament.

AWAITING RESULTS

Now I cannot say what action will eventuate. It has often happened before that initial approval of a proposition has broken down into piecemeal criticism and opposition as the implications have been more closely studied by individual interests. But I can say that I do not believe recommendations of this nature would have had the slightest chance of being accepted either by Government or by industry or by the ordinary householder or by the public press—twenty years ago, perhaps even five years ago. Now, I believe the odds are quite strong that action will follow, because it seems to me quite evident that this is the public wish; because at last there has been that growth of public opinion on which, as I said at the outset, everything in the end rests.

What is the moral of all this? I confess it is not easy to say. I think we must accept the fact that public opinion in spite of all the arts of propaganda and education—and all these must be used—takes its own time to reach a boiling point. What, I think, emerges is that propaganda and education have often been too fragmentary and haphazard, too little concerted and sustained. Again, the very extravagance of the demands of some of the most zealous has played into the hands of the doubters and the critics. Consistency and common sense are both essential in any campaign to appeal to the common man. These are perhaps platitudes. But of one thing I am certain, that here as in business, as in life generally, success comes to the man who knows his own mind and who when the moment comes can act immediately and decisively; who in fact knows how to exploit an opportunity, and at the moment of decision it is essential that the voice be clear. It is possible to have a subject so cluttered with technicalities and details, so clouded by the scientific battles of experts that, while we search for the perfect answer, the opportunity passes and nothing is done. With some experience and, in all humility, I commend this point of view and this approach to those who are engaged in the battle for clean air.