The Clean Air Act after 50 years

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The last 50 years have transformed the cities of Britain in ways it would have been hard for a post-war citizen to imagine. Air quality in the 1950s was dominated by coal smoke and even those who tried to envision future pollution in cities continued for some years to relate the problems mostly to traditional emissions from solid fuels such as coal (eg. McConnell 1970). Yet the situation now is very different and we find cities where air pollution is controlled by automobile rather than industrial or domestic sources. The nature of pollution has been influenced by many aspects of contemporary society from its leisure pursuits to the prevalence of the microchip. Nevertheless, events just over a half a century ago (Ogden 2000) stimulated the development of an influential piece of legislation: The Clean Air Act (1956) which may have had consequences even more far reaching than those intended (Brimblecombe 2002).

To understand the origins of the Act we have to return to 1952. Just as today, meteorology has a profound effect on air pollution. When stationary high pressure systems settle over Western Europe in winter, wind speeds fall and temperature inversions form. In December of 1952 this meant that the concentrations of coal smoke increased and the acid particles acted as nuclei for fog formation. As a result London experienced a deadly period of fog (Fig. 1) that would soon be called the "Great Smog" (Garner and Offord 1957). The experience of the event is elegantly described in the children's book by Philippa Pearce, *A Dog so Small* (1964) illustrating a phenomenon we can no longer experience:

> "… but later another fog began. No one could say where it was coming from, but everywhere one could taste its tang in the air, and feel the oppression of its descent. The sky seemed to thicken and at the same time to come lower – so low and heavy, it looked as if it would soon need propping up with poles. And then, at last, when all the indoor lights were on by three o'clock in the afternoon, the sky fell and lay upon London in a greasy, grey-yellow pea-souper of a London fog….
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> "All landmarks and familiarities melted into fog. Pedestrians fumbling their way home overtook slower-moving vehicles; as the fog thickened, they would come abruptly against cars abandoned half on the pavement. By that time the buses having reached the safety of their garages, refused to venture out again…. At last the fog cleared away into sparkling cold weather for the very beginning of the Christmas rush."

This fictional account matches the event of 1952 when an anticyclone spread from the north-west and became stationary over the Thames Valley (see Fig. 2). Cold stagnant air with a depth of 50–150 m allowed pollutants emitted from London to accumulate within the foggy layer. Fog on 5 December was not particularly dense, but by evening it had thickened and visibility dropped at times to less than 10 m (Chandler 1965). In central London the visibility remained below 500 m continuously for 114 hours and below 50 m continuously for 48 hours. The westerly winds of 10 December dispersed the fog and brought London's worst air pollution episode to an end.

London and its newspapers ran stories of the failure of the transport system and how people were stranded on the way home. Weekend football had to be cancelled. Indoor conditions were hardly any better than outside, and on 8 December the fully lit balcony of the Festival Hall was not visible from the stage. In Smithfield Market cattle had died and some London residents showed symptoms of respiratory illness. However, the media was also prone to exaggerate some aspects of the fog and stressed the impact of the fog on housebreaking and street crime. This may have been influenced by the strong association between crime and detective fiction as typified in contemporary works such as *Tiger in the Smoke* by Margery Allingham (1952) or the film *Lady in*

Fig. 1 The London smog of 1952 (The Photo Source London)

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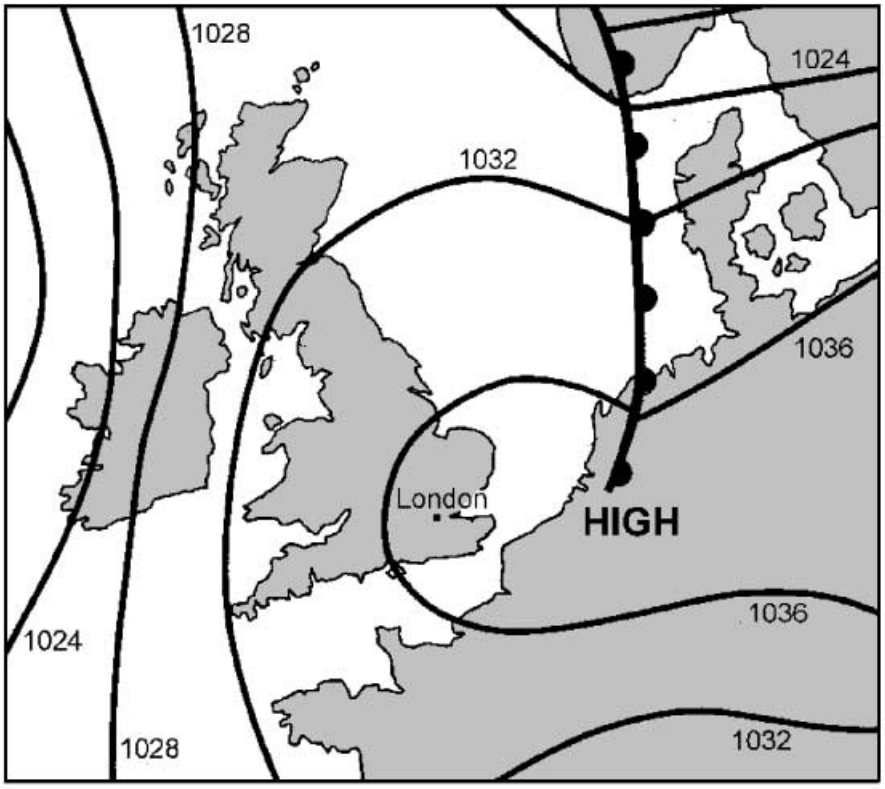

Fig. 2 Anticyclone developing over the UK 5 December 1952 (see: www.metoffice.com/education/secondary/students/smog.html).

the Fog (1952) directed by Sam Newfield. There were also fanciful stories that London was ablaze with fires that had raged unchecked because fire engines were unable to reach the burning buildings (Wise 1968).

During the fog there was a lack of awareness of the rising health consequences. An initial journalistic preoccupation with non-health impacts of the fog may explain a persistent view that the substantial increases in illness and death went unnoticed, until long after the event (Heimann 1961). This is not true as by 12 December the *Daily Express* revealed London's hospitals were crowded with people suffering a mysterious fog illness. Only a week after the fog had cleared, Ian Macleod the Minister of Health was asked in the House of Commons about the number of deaths, which he placed at 4703 compared with 1852 for the same period of the previous year. The city thus became aware of the tragedy that had befallen it. The impact was widely appreciated so on New Year's Eve when Brian David Williams (2005) a Birmingham schoolboy was composing an account of the year he wrote: "… so to December and the Great Fog – the worst London had ever known – it killed hundreds of people."

The death rates had fortunately showed a sharp fall at the end of the fog, but the analyses that followed suggested 3500–4000 excess deaths for December 1952, while other cities of England showed only modest changes (Anderson 1999). Nevertheless, there continued to be higher than expected death rates in January and February 1953, which added to the overall toll for the winter and worried contemporary investigators (Committee on Air Pollution, (CoAP) 1953). The enhanced mortality of early 1953 was often attributed to influenza (Anderson 1999), but continued effects of air pollution may have been incorrectly assigned to influenza, such that the number of deaths resulting from the smog could easily triple (Bell and Davis 2001).

Creating the Clean Air Act

Early in 1953, parliament pressed for the fog episode to be taken seriously. The Ministry of Housing was not convinced that legislation needed to go beyond the pre-existing smoke clauses of Public Health Act 1936. However, so much concern remained that the government was forced to assemble the Beaver Committee in the summer to investigate the issue (an account of the reluctance is found in Thorsheim 2004). London County Council (LCC) also set up its own Committee of Inquiry on Air Pollution which reported in November of 1953 (Rivers and Drainage Committee 1953), while the Beaver Committee rapidly produced an Interim Report for presentation in December 1953. In addition to technical matters, this report was concerned about action that could be taken to lessen the impact of future smogs. These included warning the public, advising vulnerable people and maintaining the availability and use of smokeless fuels (CoAP 1953).

In November 1954 the Beaver Committee issued its final report which was generally well received. This report recommended that there be a Clean Air Act (CAA) and most notably that this would move beyond industrial sources to cover domestic emissions. In this it was more stringent than the recommendations envisioned by the LCC. The LCC also worried that smokeless fuels would not have any affect on sulphur dioxide emission. The development of the CAA began as a private Bill of the Tory MP Gerald Nabarro. Narbarro had been well briefed by the National Smoke Abatement Society before the Bill was read. This allowed him to give strength to the Beaver recommendations. The Bill gained wide support including that of colourful MPs such as Enoch Powell, so that the government was forced to put forward its own bill. This was debated in November of 1955 and received royal assent on 5 July 1956 (Ashby and Anderson 1981).

Although politicians had believed that smoke was already regulated under the Public Health Act 1936, the CAA 1956 ultimately had more than 40 clauses compared with only six in the earlier Act. The tone of the CAA was more modern and focused on what we now regard as the environment. Furthermore, it had to grapple with the domestic chimney and confront the issue of freedom of choice. Challenges to personal freedom by controlling what people could burn in their own homes was a worry for elected members of parliament. There were parallel concerns about the availability of smokeless fuels.

The new Act continued as earlier smoke abatement clauses and had to foster practical approaches: a focus on smoke, exempting some practices and funding research. The detail of how the CAA would work is largely found in memoranda on chimney heights, smoke control areas and industrial premises. This is characteristic of the current European Directive 96/62 Air Quality Monitoring and Management where much of the detail is found in daughter directives and position papers. The CAA was seen both in the UK and abroad as an important example of environmental legislation although many correctly observed that it failed to address the problem of sulphur dioxide. In 1959 the government began the national survey of air pollution, which sought evidence that the Act was effective. The monitoring data gathered emerged as the *National Survey of Air Pollution* that were published as regional analyses of changes in air pollution over the years, 1961–1971.

Legacy

The substantial improvements in UK air quality from the 1950s received much comment and were often attributed to the CAA. However, evidence of this relationship was not always convincing. The Act was not passed until 1956 and not implemented in many areas until much later. Few studies took time to look at the longer term record of generally improving air pollution that in some cases stretched back to almost 1900 (Brimblecombe 1987). It was also evident that along with smoke, sulphur dioxide was also in decline, yet this was not controlled by the CAA. Recent appraisals of the mid-twentieth century improvement in air have been more thoughtful. The *Quality of Urban Air Review Group* (1992) concluded that dramatic reductions in the concentrations of smoke and sulphur dioxide from the mid-twentieth century were "brought about as a result of burning cleaner fuels, especially the use of gas; tall stacks on power stations, and their relocation outside cities; and the decline of heavy industry." Giussani (1994) concluded that improvements in air quality after the passage of the CAA were related to activities in the industrial sector.

In the domestic sector there were huge shifts, with the all-electric house and gas fired central heating. Such lifestyle changes across the twentieth century made the domestic energy sources desired by the Act much more acceptable (Brimblecombe 1987). This meant that the worry about the availability of smokeless fuel which were prevalent in the 1950s became unimportant. The CAA was extended in 1968 and both Acts were repealed and consolidated by the CAA 1993 and recognised that the reduction of smoke may also help control other pollutants such as particles, sulphur dioxide, polycyclic aromatic hydrocarbons, dioxins and furans. In smoke control areas the CAA 1993 enables local authorities to designate areas in which smoke may not be emitted and fuels will only be permitted if the sulphur content is less than 2% and are effectively smokeless.

Into the 21st century

There were rapid changes in air pollution sources in the last part of the twentieth century when liquid and gaseous fuels replaced solid coal except in the largest plants such as power stations. Even here there was a move to gas. It was the automobile that most characterised the shift in emissions, with special significance attached to the volatile organic compounds emitted within exhaust gases and from the fuel. The evidence for these changes in London is very clear as we can see a remarkable reduction in pollutants such as sulphur dioxide and black smoke (Fig. 3), but less improvement in nitrogen dioxide. Nitrogen dioxide forms from nitric oxide emitted from automobiles. There have been some reductions of nitric oxide emissions in the UK but chemical reactions in the atmosphere make the reduction in nitrogen dioxide less significant.

Additionally, the automobile and industries using solvents have been responsible for substantial amounts of reactive organic material in London's air. These new emissions react under sunlit conditions to promote photochemical smog characterised by high ground level ozone concentrations. Although the amount of smoke in the air has declined, a rising number of diesel vehicles has increased the amount of the very smallest particles (just a few microns across) in the air. We now realise that these small particles (PM-10 and PM-2.5) are strongly associated with health effects of pollutants.

The changes in the nature of urban air towards the end of the twentieth century were paralleled by the development of a substantial body of European Union legislation that addressed air quality under the European Directive 96/62 Air Quality Monitoring and Management and its daughter directives. More recently, air pollution has been the focus of Clean Air for Europe (CAFE). In September 2005 the European Commission proposed a streamlined clean air strategy to protect human health and the environment aiming to cut the annual number of premature deaths from air pollution-related diseases by almost 40% by 2020 (compared with the 2000 level). CAFE pays special attention to fine particulate material and ground-level ozone. It also aims to substantially reduce the area of forests and other ecosystems suffering damage from air pollutants.

London has continued to take some pioneering approaches to improved air pollution. Mayor Ken Livingstone was willing to confront issues of personal freedom by promoting a system of congestion charges for vehicles accessing the central parts of the city. The charges have brought some improvements to air pollution not only by lowering the number of vehicles, but also through improved traffic flow (Beevers and Carslaw 2005). Concerns that the required increase in the number of buses would raise the concentrations of fine particulate matter appeared misplaced as newer vehicles have lower emissions.

Conclusions

The last 50 years have seen great changes in the quality of urban air. The traditional pollutants of sulphur dioxide and coal smoke have gone. True they have been replaced by pollutants that derive from vehicles in urban areas, but there is none of the inevitability that was attached to air pollution in the mid-twentieth century. Air quality is regulated by increasingly detailed legislation especially from the European Union. The Clean Air Act of 1956 has now been repealed and consolidated into the Clean Air Act of 1993. Our view that it was responsible for a half-century of improvement in air quality is now a good deal more cautious. However, it remains a seminal piece of legislation because it created a belief that a better environment was possible and worthwhile despite the fact that at times it would restrict our individual freedom.

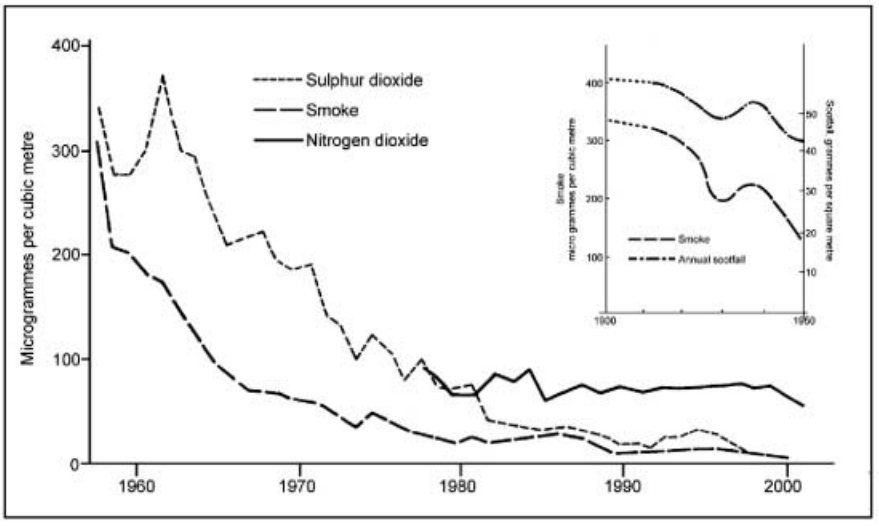

Fig. 3 Changes in concentration of London's air pollution over 50 years. Data: Smoke and sulphur dioxide County Hall – 1989 then Westminster 17 (Greater London Authority 2002) and nitrogen dioxide London Victoria – 1990 and Bloomsbury – 2001. Inset shows the declines in smoke deposit in London and smoke concentrations prior to the fog of 1952 (Brimblecombe 1987).

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Snow falling from a cumulonimbus in the Lunedale valley, Cumbria on 9 April 2006 © Neil Barker