

CLEARING THE AIR

The Beginning and the
End of Air Pollution

Tim Smedley

B L O O M S B U R Y S I G M A
L O N D O N • O X F O R D • N E W Y O R K • N E W D E L H I • S Y D N E Y

Prologue

My first daughter was born in London in March 2014, at St Mary's Hospital in Paddington, on the first day of spring. The sky was a brilliant blue and daffodils burst yellow with optimism from grey concrete pavement pots. I staggered out into the mid-morning to a new day, a new life, with all the hopefulness of fatherhood and new beginnings (and an urgent order for coffee to fulfil). But I was oblivious to the fact that I was walking down one of the most polluted roads in one of Europe's most polluted cities. I also didn't know that we were in the middle of a month-long air pollution episode that would cause 600 deaths in London plus 1,570 emergency hospital admissions – some at the very same hospital I had just emerged from.

In the coming weeks and months of that year, however, I started to become aware of air pollution. I hate myself for fitting the cliché, but yes, parenthood did suddenly make me more aware of risk. The scene in the film *Paddington* where the Browns arrive at the maternity ward as carefree hippies on the back of a Harley-Davidson and leave nervously in a grey family car with their new arrival, rings embarrassingly true. As a sustainability journalist I had covered environmental issues for years for the *Guardian*, *Financial Times*, BBC and the *Sunday Times*. But I hadn't paid much attention to the most immediate environmental issue of all: the air we breathe. If I thought of air pollution at all, I thought of smog – and smog was something other countries suffered from. But now, with an infant to protect,* I started to notice the visceral throb of traffic in central London; the brown tinge to the sky even on cloudless days; the blackened nostrils after commuting on the Tube.

* And I *totally* agree that you don't need to be a parent to notice these things. In fact, more shame me for failing to act before passing on my genes.

My awakening seemed to happen in parallel with that of other Londoners, too. London's Mayor Boris Johnson confessed to the *Evening Standard* in December 2014 that Oxford Street had the worst diesel pollution on Earth. To say this came as a surprise is something of an understatement: the shopping street where I took my daughter to pick out her first pram had some of the most polluted air *in the world*?! Where were the health warnings, the public information signs, the protesters marching? All I could see were happy, oblivious shoppers. Barely a week into 2015 came another *Evening Standard** headline: 'Oxford Street pollution levels breached EU annual limit just four days into 2015'. The article said things about 'the EU limit for nitrogen dioxide (NO₂) levels ... above 200 micrograms per cubic metre' and something regarding 'tackling diesel pollution'. But I had no idea what any of those things meant. What is nitrogen dioxide? Why is it bad? And what's the beef with diesel?

My professional instincts kicked in and I began to research. This started with a few articles, for the BBC and others, but soon the topic blew up. And not just in the UK, but in cities across the world. The smog in Beijing, China, was becoming so bad that it was dubbed the 'Airpocalypse'. Pictures circulated on social media of Beijing students sitting their exams so couched in smog that they could barely see the neighbouring table. Stories emerged from Delhi, India, such as the *Guardian*'s 'Toxic smog covers Delhi after Diwali' (31 October, 2016), which pointed the finger at 'the density of some harmful particles and droplets in the air ... up to 42 times the safe limit'. Particles of what, I wondered? Droplets of what? What safe limit? And then came the death figures. In late 2016, the World Health Organisation (WHO) announced that outdoor air pollution caused over 3 million deaths worldwide; by 2018, the WHO revised this up to 4.2 million.† In the UK, according

* I don't have any affinity with the *Standard*, but as a Londoner, with vendors at every tube station, its headlines are unavoidable.

† 7 million, if you include indoor air pollution. This book will largely focus on outdoor air pollution, however, because it is the one thing we all have in common, and that we have a collective responsibility to fix.

to the Royal College of Physicians, 40,000 people were dying each year from air-pollution-related illnesses. But what were these airborne illnesses?

I decided I had to go to these cities and meet the experts who could tell me what the hell was going on. And when I did, the depth and breadth of what they had to say made it clear that this was not going to be a series of articles – this was a book. In the words of the eminent American epidemiologist I spoke to, Dr Devra Davis, ‘those felled by environmental conditions seldom even know why they are dying’. It’s about time they were told.

Some of the stories I encountered were painful to hear. Beijing citizens told me of smogs so bad that the sky turned black in the middle of the day, and persistent illnesses that never went away. When I landed in Delhi in late 2017, I experienced some of the worst smog I’d ever seen or inhaled – and yet the general mood in the city was jubilant, because the conditions were far better than the week before, when even the street dogs started dying from heavy smoke that clung to the ground and entered people’s homes like an intruder. The Delhi half marathon went ahead that week, regardless, with runners wearing face masks and complaining of burning eyes.

Mexico City was more polluted than Delhi in the 1990s. Melba Pria, now the Mexican ambassador to India, told me of her experiences as a young adult in the city back then, when the crisis peaked: ‘The Ministry of Education tested sixth-graders [11-year-olds], and 80 per cent of the children in Mexico City said that the sky was grey and 10 per cent said the sky was brown. Only 10 per cent said that the sky was blue ... Then birds started falling from the sky. Little birds. Suddenly you found dead sparrows in the walkway ... In Mexico City despite everything else, you have lots of hummingbirds. Then there were no hummingbirds to be seen. It was like, “These are our birds, how is it that they are not there any more?!”’ The smog was so bad that all the schools were closed for two consecutive months. ‘I remember a colleague of mine, and I remember it very clearly because it was very shocking for me,’ says Pria.

‘Her kid was at home [during the school closure]. She was telling me that her kid was locked in the apartment. The boy said one day, “Mummy, my window friend is ill today”. The mum said, what do you mean, “window friend”? The boy had made friends with another boy from another building that was relatively far away – they would play together by making signs from window to window, because they weren’t allowed to leave the house. That was very disturbing to me.’

Yet I also found a powerful message of hope. Today, Mexico City has cleaned up its act. It ranks way down the WHO’s list of most polluted cities – down in the 900s in fact, with air comparable to the medieval Italian city of Carpi and the famous cycling destination of Roubaix in France. Cities have reached untenable smog levels before and pulled themselves back from the brink. Through political and public will, they found effective solutions. In the first half of the twentieth century, the burning of dirty coal in domestic fires and inner-city power stations conspired to shorten the lives of almost all urban residents, culminating in the US in the Donora, Pennsylvania, disaster of 1948,* and London’s Great Smog of 1952. The outcry, legislation and behaviour change that followed led to the UK Clean Air Act of 1956, a global landmark in environmental legislation, and the US Clean Air Act of 1970.

Unlike in Donora or the Great Smog, however, today’s smog is largely invisible – the thick coal smoke replaced by tiny particles and chemicals. Modern science is starting to reveal what our eyes cannot see: an anonymous killer born from the cars in our driveways and the industrial processes used to make the products in our cupboards. But most people don’t read modern science journals. Parents on the school run in their SUVs have never been told that the pollution inside their car can be four to five times worse than that on the street outside. Or that decades of studies in Europe and America show that air pollution stunts lung growth in

* I look at the Donora disaster in more detail in Chapter 4.

children. Or that the air pollution affects us at every stage of our life, from reducing our fertility levels to causing heart attacks and dementia.

Nick, a London cyclist hospitalised due to long-term exposure to air pollution, told me: 'Pollution is a slow, grinding, background thing, and people aren't very good at reacting to slow, grinding, background things. We all have our heads in the sand about this. And it's made worse by the fact that we can't see it. It needs to be made real to people.' We still have some visible plumes of coal smoke, notably in Poland, India and China. But the common foe that unites all cities is cars. I discovered that even the newest cars give off large exhaust plumes of invisible nanoparticles and nitrogen dioxide gas – that are amongst the deadliest adversaries we face. David Newby, a professor of heart medicine, tells me in Chapter 3 how nanoparticles appear within our bloodstream, clogging up our arteries and causing high blood pressure and heart attacks. These traffic-derived pollutants appear in each and every street with cars. They will appear in your street.

A refrain I came across a lot is the 'it never did us any harm' argument. That 'when we were kids we drove X or burnt Y and look, we're fine'. But often, if you dig a little deeper they admit to some lingering health problem such as asthma, persistent lack of fitness, hay fever, high blood pressure or worse. For example, when I was a child in the 1980s every car on the road ran on petroleum mixed with lead. Childhood lead exposure is known to reduce the parts of the brain responsible for mood regulation and decision-making, leading to reduced impulse control and more aggressive behaviour. The natural background level of lead in human blood is around 0.016 micrograms of lead per decilitre of blood ($\mu\text{g}/\text{dl}$). Due to the global use of leaded petrol however, from 1976 to 1980 the median blood lead level of US children aged under five was $15\mu\text{g}/\text{dl}$ – almost a thousand times higher than it should be. From 1979, researchers in Cincinnati recruited pregnant women, took blood tests from babies and then repeated them every year until the children

were six and a half years old. When these data were overlaid with criminal records up to October 2005 (this was a very long study), they found that increased blood lead levels were associated with higher rates of arrest, particularly for violent crimes – unsurprising, really, if you’re poisoning them with something that inhibits mood control. For every 5 µg/dl increase in blood lead levels at six years of age, the risk of being arrested for a violent crime as a young adult in the US increased by almost 50 per cent.¹

Similar ‘lead and crime’ studies have since been carried out in other countries including the UK and Australia, all broadly coming to the same conclusion: even after adjusting for major demographic variables (age, education, income, etc.), lead in the air remained the largest determinant of variance in violent criminality. Uta Frith, Emerita Professor of Cognitive Development at University College London, studied the impact of lead poisoning in children living near busy roads in east London in the 1980s. She recalled for the BBC in 2018 that, ‘the results were overwhelming and could not be dismissed as due to other factors such as parent’s socio-economic status ... there was a detrimental effect on children’s cognitive abilities and behaviour, and decreases in IQ test scores could be precisely linked to increases in the amount of lead in the blood ... That was a revelation.’²

The story of lead pollution is a modern parable. It begins with a single greedy corporation looking to make profit from a known poison (I’ll tell that story in Chapter 3). It also shows the power and reach of a single type of pollution from a single source: the automobile engine. Owing to that one minuscule period in the Earth’s history, a thin layer of lead now covers the entire planet. Some of which came from my parents’ 1980s Volvo. But like Mexico City, leaded petrol also has a happy ending. It is one of the few examples of the international community coming together, understanding a major health issue and banning the pollution source that caused it. Most developed countries phased out leaded petrol, specifically because of its detrimental health effects, in the 1980s and

1990s. The levels of lead in children's blood in the US decreased by 84 per cent from 1988 to 2004. By 1999 the median blood level among US kids was down from 15µg/dl to just 1.9µg/dl.*

Other common refrains I came across are that 'there is no one-size-fits-all solution', and 'of course *this* city is different'. But in fact, as my research progressed, a blueprint did emerge for a clean-air city. I found that my outsider 'non-expert' status quickly became a strength: academics and policy makers from other areas talk to each other a lot less than you might think, pushed into silos and specialisms by the nature of their work. As someone memorably told me during my research, 'When I go to conferences, all the epidemiologists sit on one side of the room, and all the toxicologists sit on the other side.' By my visiting both sides of the room, across many different disciplines and countries, an action plan formed that others can follow. Throughout the pages of this book, I'm going to spell out what it is. But here's a spoiler: if you think (as I used to) that the stuff you burn, from a cosy log fire to the fuel in an engine, isn't doing you or your neighbours any harm, then you're in for a shock.

I describe the chemical cocktail of pollutants in our air in Chapter 2, but there is one I need to introduce from the very start, because it's going to crop up a lot: particulate matter (PM). These are the tiny solid particles that float in the air, from road dust to smoke, that do us the most long-term damage. Scientists define PM not by what the particles are made of (i.e. coal smoke, agricultural dust, engine fumes) but by size. The large ones are called PM10 – so named because it refers to any particle measuring 10 micrometres in diameter or below, roughly a tenth of the width of a human hair. PM10s can be seen by the naked eye as smoke or haze. In typical conditions, PM10s are also easily filtered out by our

* Albeit still a hundred times greater than the natural level. According to toxicologists, there is no known 'safe level' of lead pollution.

body's natural defences, such as nose hair. Smaller PM_{2.5}s, however, with each particle less than 2.5 micrometres in diameter, are a different matter, and their little sisters the 'nanoparticles' even more so. Typically the result of modern combustion techniques, they are much too tiny to see even in large quantities, can bypass our bodies' defences, and pass through the walls of our lungs and directly into the bloodstream. It's not a spoiler to say that PM_{2.5} will be a major focus throughout the book, as indeed it is a major focus of modern air pollution science and regulation.

Comparing the PM_{2.5} levels in different cities is not always straightforward. PM is measured by the mass of particles found per cubic metre of air ($\mu\text{g}/\text{m}^3$), and while the WHO recommends a health-based limit of $25\mu\text{g}/\text{m}^3$, most countries and regions have their own limits, such as $50\mu\text{g}/\text{m}^3$ in the EU or $65\mu\text{g}/\text{m}^3$ in the US. The official monitoring stations used to capture these measurements are often too few in number, or poorly positioned – in many cities I came across a public suspicion that they are purposely placed in relatively clean air locations, in order to skew the numbers. So, while I do refer to official readings where available, on my travels for this book I also carried a portable PM_{2.5} monitor called the 'Laser Egg 2'. I could turn my 'Egg' on and check the PM_{2.5} $\mu\text{g}/\text{m}^3$ reading wherever I went and, while levels in one street can be very different from levels in another, it was a useful reference tool.

And there's a gas I want to deal with from the start, too. Or rather, a category of gases: greenhouse gases. Local, ambient* air pollution differs from climate change in a number of important ways. We can breathe in the main greenhouse gases, carbon dioxide (CO₂) and methane (CH₄), in surprisingly high quantities in the air with no real harm to our health. Equally, the common air pollutants that cause us

* Ambient is just another word for 'outdoor' air, as distinct from indoor, and is used by the likes of the WHO. It needs mentioning, as many voluminous reports only ever use 'ambient', but I'll mostly just say 'outdoor' from now on.

the biggest health problems – namely PM2.5, surface-level ozone and nitrogen dioxide – tend to have negligible global warming effects (although there are exceptions, as we shall discover). The easiest way to separate the two issues, however, is also what attracted me to writing about air pollution: it is a local problem, and solvable locally. While carbon emissions from one country contribute to the changing climate globally, the same is not so true of air quality. There are some ‘transboundary’ air quality issues, with one country’s pollution blowing over their borders into neighbouring states, but for the most part the pollution is hyper-local. The smallest particles, nanoparticles, only exist within metres of their source; the lifespan of nitrogen dioxide is typically no more than a day, and often much less, meaning it can’t get very far – you won’t find any in remote rural regions; surface-level ozone is so highly reactive it can disappear within hours. So, if your town or city carries out all the measures outlined in my blueprint, you *will* breathe in cleaner air, irrespective of what your neighbouring state does, or what countries on the other side of the world get up to. Even if you only convince the people on your street to follow the blueprint, while the rest of your town continues to pollute, the air on your street will be measurably cleaner than other, neighbouring streets. And it just so happens that most of the measures to reduce outdoor air pollution tend to reduce greenhouse gas emissions and tackle climate change too.

When I walked out of that London hospital in 2014, however, I didn’t know any of that. As I nervously helped my recovering wife and our one-day-old daughter towards the awaiting grey family car, we were exposed to a high air pollution episode that very day. The pollution episode of March 2014 wasn’t actually reported accurately until December 2016, in the specialist science journal *Environment International*. The researchers revealed that a pollution peak had been dismissed by the government at the time as merely a cloud of ‘Saharan dust’ – a natural phenomenon and an easy scapegoat. However, according to the journal authors it was in fact nitrogen dioxide caused by London traffic pollution

mixed with agricultural ammonia from nearby farms – Saharan dust made up less than 20 per cent of it. When I read that, I was both angry (how could a government mislead its people on such an important issue?) and intrigued (how can cow pee from farms foul up the air?). I had a lot to learn. It proved to be an exciting, at times blood-boilingly infuriating, but ultimately hope-filled journey.