Chapter 7 New Draft: Historical geography of Toronto's Air Pollution

Introduction
In 1856 the firm of Armstrong, Beere & Hime made a series of 25 photographs of the streets of Toronto. The city's earliest landscape photography, it was part of a scheme to persuade the British Colonial authorities to make Toronto the permanent capital of the Canadas. The photographs show the city's thoroughfares and buildings, and a good deal of its vernacular detail. You can make out puddles in the muddy streets, and piles of lumber stacked in the back yards. Businessmen in top hats stand outside the stock exchange. Laundry flutters on washing lines and ladders loiter beside piles of bricks. It shows the city in a mixture of grandeur and ordinariness. Some of the pictures were taken in clear atmospheric conditions, but in most of them the urban landscape vanishes into haze.

The haze is one of the fascinating properties of the Armstrong photography. After a block or two, sometimes three or four, buildings fade into murky obscurity. Vision is limited to the middle distance, except when looking out to the lake. Of the 25 pictures, at least 16 show compromised visibility. Of 13 shots taken from the roof of the Rossin House, for example, 9 show visibility limited to 400 metres. Bad as this seems, it got worse in the downtown core. Buildings in some of the downtown photographs vanished into haze around 250 metres or less.

We have here a situation in which a firm of professional photographers, with good equipment, engaged in a prestige project, able to choose camera positions and light conditions to best effect, is forced to shoot 65% of its pictures in visibility conditions which meteorologists would define as fog.

The city's photographic record expands a little in the 1860s and early 1870s, with the work of Octavius Thompson, William Notman and others. However, hazy visibility remains a characteristic of the street scenes of the period and long afterwards. You could find clear conditions with unrestricted visibility, but photographers often had to work in haze. The photographic evidence tells us that generally speaking you couldn't see very far in Victorian Toronto. This was especially true downtown, and a limit of 200-400 metres of visibility was frequent in the city's commercial core.

These conditions stand in strong contrast to those of the present. Even with Toronto's distressing tendency toward summer smog, you can generally see further downtown today than you could 150 years ago. Compared to today, the Victorian city had much shorter visual range [VR] and a much higher Coefficient of Haze [CoH].

Fog occurs in Toronto, but it is not very frequent. Cloudy weather is more common, but it seldom produces the restricted visibility you see in historic photographs. The limited visibility of Victorian Toronto cannot really be explained by weather and climate alone. It was the air pollution.
Mapping Historic Air Pollution
We can't measure Victorian air pollution the same way we would today. It is not just because we can’t instrument the air of the past, it is also because the pollution has changed. Ontario's present-day air pollution monitoring facilities are designed around the present mix of air pollutants, and are not designed to measure the old-style coal smoke derived from low-efficiency combustion.

We might attempt to sample the dustfall of historic air pollution, as some have done, and read its chemical signature. This is specialised, painstaking, and expensive work. It is fairly easy to catch the large dust particles close to the point of emission, but most smoke particles are tiny. They take months to settle out of the atmosphere, and may travel for thousands of miles. Smoke from Sudbury's nickel smelters settles out in the in the Canadian Arctic. The distinctive chemistry of the Sudbury emissions helps scientists trace its source, but most of the atmospheric muck is more nondescript and harder to trace.

There have been a few studies of the air pollutants settling out much closer to their sources. At various times Toronto attempted to measure air pollution this way. Small numbers of dust jars were placed on building roofs in an effort to trap airborne particles for later analysis. In other cities researchers have tapped into the sedimentary records of bogs and lake beds. Miriam Diamond and her collaborators at the University of Toronto have focussed on the thin films of chemical contaminants which adhere to urban structures. They have the patience and expertise to analyse them layer by microscopic layer.

Logging and analysing air pollution sediment is a slow and expert business with many frustrations. Disturbance is the rule, rather than the exception for urban soils and sediments. People have a habit of washing the windows from which Miriam Diamond likes to scrape her chemical film samples, ruining her results. If you can find an undisturbed sample, you face the questions of how representative it may be. Bogs and dust jars have a tendency to accumulate the larger air pollution particles, leaving the smaller ones to fly on further. If particle chemistry is connected to particle size, then it raises new problems of interpretation. How do you reconstruct the chemistry of historic air pollution if you can't be sure you have a representative sediment? At best there is only a generalised connection between airborne pollution, and the sedimentary record it might leave in a dust jar or a bog.

A few measurements exist, achieved after some considerable effort, but nobody has so far managed to make real maps of historic urban air pollution this way. The few we have come from surviving sets of air pollution data somehow bequeathed by the past. One scientist in Victorian London, England, for example, placed buckets on the roofs of fire stations and collected samples of rainwater across the city. He was able to determine the SO2 content of London's rain. We can only map this data where it survives, but not where it doesn’t. And mostly it doesn't exist. The field of historic urban air research therefore needs a productive technique for mapping historic air pollution. We need an archeometric procedure, something which allows us to make measurements of the past.
Photographs provide an interesting opportunity to do this. Anyone who has spent time looking at old urban photographs is likely to notice the smoke and haze. Coils of smoke belch from Edwardian factory chimneys, and from 1920s steam trains. Puffs of smoke emerge from the sepia-toned tailpipes of tin lizzies, from steamboats and domestic flues. In photographs of the inner city, among the slum dwellers of Chicago or the pedestrians of Manchester, around slums or proud edifices, the clarity of the urban foreground quickly fades into fuzz. Even under the present-day smoggy urban skies, there is something startling about the thick urban hazes of the past. Just as in Toronto, even in good daylight, you couldn't see very far.

Photography does not take us back very far in the history of the modern city. The first photographs were taken in the 1830s, and the very first street scene (in Paris) was taken in 1839. We have to wait for the 1850s for photographic records to begin in most major cities, but after that it flows continuously. Toronto is no exception. The street scenes of Armstrong, Beere & Hime are about the earliest photos taken in the city, and they are certainly the oldest of its street scenes. There are hundreds of thousands of historic pictures in the various archives of the city. The City Archives, the Toronto Public Library are simply two of the best known repositories. The City Archives claims to have a million images in its collection, and this is growing all the time.

Toronto pictures turn up in national and provincial archives, and especially in the vast picture collections assembled by city's newspapers. Most pictures are still unavailable for public use. It takes scarce funds to grant access. Very few of the tens of thousands of negatives assembled by the Globe & Mail newspaper, for example, have been microfiched by the City Archives. Funds to digitise the Toronto Telegram's photos ran out when York University's archives reached the letter "C". For now we must make do with what we have.

Researchers have ready access to around 4,500 historic Toronto photographs, enough to provide a wealth of visual data. In researching this book I have drawn on about 1,400 of these pictures, choosing the ones which seem to show the city's atmospheric quality from the 1850s onwards. The clearest visibility usually comes from the pictures taken in the suburbs or completely outside the city. For many years, the pictures taken in the city's core were hazy. Sometimes you can pick out individual point sources of smoke, but often you are looking at a generalised smoke haze, diffused and impossible to attribute to a single source.

In most cases we know, or can work out where the photographer was standing when the shot was taken. It is also fairly easy to date the photograph, at least approximately. It is also possible to measure the extent of visibility in each picture, assuming that the camera was focussed on infinity. The outlines of buildings remain visible for some distance, but one notices the secondary architectural details vanish pretty quickly. Window ledges, masonry details, finials and other subtle features disappear into the haze while you can still make out the stronger contrast of building outlines. For my measurements of urban visibility I have focussed on the secondary architectural detail.
Plotting the photo onto a map or GIS allows visibility distance to be measured, in metres. If one collects together decadal groupings of urban photos, and plot their visibility distances on a map, you can generate isolines fairly quickly. Isolines are "contours" of equal statistical values, in this case showing equal visibility. We can repeat the process for any time period for which we can assemble an adequate body of photos.

Computers also allow the visibility distance to be given a statistical value. Many image processing applications contain the necessary statistical functions. Corel Photo Paint, for example, has facilities for computing histograms and other measures of the gray scales of a black and white photo. You can compute averages and measures of central tendency. After some experimentation it would seem that secondary architectural detail vanishes for me once the standard deviation drops below 15 on Photo Paint's 256 gray scale analysis. Precise calibration of this technique awaits further research, but it is an interesting analogue to some of the techniques used in remote sensing.

The measurement of visibility distance on historic photos is a conceptual analogue of several techniques used in the scientific measurement of air pollution. Visual Range [VR] is an imprecise but recognised way of gauging air pollution. Meteorologists focus on the high-contrast conditions of objects silhouetted against the sky to determine Visual Range, but we are following similar principles if we focus on secondary architectural detail. The more muck in the atmosphere, the more difficult it is to see very far, or well.

The Co-efficient of Haze [CoH] is another analogous measure. It uses an athelometer, a "soot-measurer" to produce an index. Created in the mid 1950s, before SI units, it requires 1,000 feet of air to be drawn through a filter medium. The instrument determines how much light is being obscured by the trapped dust particles, and gives a reading. CoH is becoming superceded by more precise methods of air sampling, but it entered service in the mid 1950s and is one of the more long-term of our air pollution sampling methods. Its records go back a long way. Metro Toronto started measuring CoH in 1958, and Ontario still records it as part of its air monitoring programme. Recent interest in atmospheric black carbon [BC] has revived the technique. Black carbon turns out to have a significant role in urban smog formation, and in global warming. Athelometers, it appears, may be a good way to measure BC in the present. We have long runs of data running back into the 1950s, allowing historic change to be assessed.

So the measurement of visibility distances in historic photographs has analogues in the science of air pollution. When we measure visibility, whatever the limitations, we are actually measuring air pollution much of the time.

Our photometric technique, measuring visibility distances in photos, is a cheap, simple and relatively quick way to generate a lot of mappable data about historic air pollution. It might be repeated in other cities, and the data it generates can easily be crosschecked against other data sources. Much of this will happen during the course of this book. It is also a technique which can be refined in time. If one wants a map of air pollution in (say)
1903, it is possible to select an appropriate time-grouping of pictures to deliver this. It is a flexible archeometric technique.

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of photographs used</th>
<th>Maximum number of air sampling stations in use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1860s</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>1870s</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>1880s</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>1890s</td>
<td>78</td>
<td>0</td>
</tr>
<tr>
<td>1900s</td>
<td>114</td>
<td>0</td>
</tr>
<tr>
<td>1910s</td>
<td>305</td>
<td>0</td>
</tr>
<tr>
<td>1920s</td>
<td>389</td>
<td>0</td>
</tr>
<tr>
<td>1930s</td>
<td>191</td>
<td>4</td>
</tr>
<tr>
<td>1940s</td>
<td>81</td>
<td>0</td>
</tr>
<tr>
<td>1950s</td>
<td>131</td>
<td>20</td>
</tr>
<tr>
<td>1960s</td>
<td>50</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 1 A comparison of air pollution sampling points

Photometric visibility analysis also has another important property. In this study it takes 1,400 photos to map the changing visibility patterns of the city. When Metro Toronto unrolled its most ambitious air monitoring programme in the late 1950s and early 1960s they never had more than 30 sampling points [Table 1]. Metro's sampling instruments will be much more precise than my measurements, but they were also much more spread out. The instrumental network did not remain this size for long, and has contracted greatly since. When it comes to making a map of air pollution, the precise measurements of instrumental monitoring are spread too far. The hundreds of photos available for visibility analysis, while less precise, are far more numerous. There is a sense in which photometric visibility analysis is going to yield a much finer spatial texture of information than instrumental networks have ever reported. Many of the photos are clustered in the city's congested areas, improving detail in critical areas. The only way to get better spatial texture is to use satellite imaging.
The Historical Geography of Toronto's Air Pollution

Air pollution began in Toronto well before the city's first photographs were taken. In July 1802, for example, the Justice in Quarter Sessions at York [Toronto] ordered that joiners, cabinet makers and woodworkers who destroyed their shavings by burning should do so at sunset on Wednesdays and Saturdays. The population of the settlement was tiny, and the number of affected tradesmen even smaller, but it sounds like an attempt to regulate the nuisances posed by open burning.

Before the 1850s the city was quite small in size, and before 1832 essentially a village. It was addicted to firewood, and very few complaints reached the newspapers or municipal authorities about urban smoke. Captain Bonnycastle in 1841 thought Toronto's wood smoke was an advantage which might attract settlers. It kept the mosquitoes away, he said.¹

Susannah Moodie, an iconic writer of Victorian Canada provides us with another glimpse of the air pollution of the early city. She first came to Toronto in August 1852, arriving by steamer. As her ship drew into Toronto Bay early in the morning she could see the city wreathed in a "grey mist".² Perhaps she was describing the foggy conditions which sometimes strike the city in that season, but it might have been air pollution, or some combination of the two.

Toronto by that time was a city of 40,000 people, and that it was burning significant amounts of wood and coal. It was a city of 4,500 homes,³ each of which had at least one stove or fireplace. Its waterfront received the smoke of 12 steamboats on regular service,⁴ plus the smoke of the gas and water works.

During the 1850s Toronto experienced an economic and building boom. Three railways reached the city, new industries were added and the population grew significantly. To accommodate the railways, there was extensive lake filling along the waterfront. Coal burning, begun on a modest scale in the 1840s, became much more widespread and intense. Shortages of firewood led to coal being used for heat and power, while new industries emerged, such as the Rolling Mills, which depended on coal.

The Rolling Mills were constructed on the city's eastern waterfront, near the mouth of the Don in the later 1850s. The fuel shipping season of 1859 showed the company building up its winter coal stocks before commencing operations. It was intended to forge and re-forge railway materials, especially rails. In the early 1860s this industrial behemoth would become a smoky presence in the city's east end. Here, amid steam hammers and powered shears "a hive of Vulcans"⁵ fed 10 furnaces with coal and a great deal of the region's scrap iron. It had four 100-foot chimneys and a steam whistle which could be

² Susannah Moodie (1853) Life in the Clearings (Toronto: Macmillan) p. 205.
³ Canada Census lists 4,251 dwellings in Toronto in 1851.
⁴ William H Smith (1846) Smith's Canadian Gazetteer (Toronto: H & W Rowsell) p. 194.
heard for 15 miles. Its air pollution consequences were immediately apparent. "Everyone must have noticed the ranges of chimneys which have recently risen" said the Globe in 1860. “From all parts [the Rolling Mills chimneys] may be seen with black, fuliginous clouds pouring up from them by day and fiery glow by night, putting one in mind of the sights of Warwickshire or at Carron at home".

The 1850s and 1860s brought increases in steamer traffic, especially to Toronto's central waterfront. This was where the passengers embarked and disembarked, and where they connected with the railways. The expansion in railway traffic seems to have stimulated the increase in steamer service. Although they burned wood until the 1870s, the railway locomotives of three companies added a good deal of smoke to the waterfront, and the city's central core.

Armstrong, Beere & Hime's famous photographs show that by 1856 visibility had already diminished in Toronto's commercial core. From roof of the Rossin House at the west end of this district, you could look across to the Island, and pick out the silhouettes of individual trees, 2,800 metres away. But if you looked into the city, or north to Osgoode Hall, the visibility faded dramatically. Some of the point sources can be identified, and the chimney of the water works at the foot of Peter Street is obvious, obscured by its own smoke.

In July 1858, less than two years after the photos were taken, Albert Furniss who owned the waterworks was fined £25 in Recorder's Court for the smokiness of his chimney. We are told that "a large number of respectable citizens gave evidence to the effect that they considered the escape of smoke to be a very great nuisance". The chimney was one of the city's point sources of smoke, but compared to the Rolling Mills, hardly a major one. The difference lay in the people it affected. In 1858 the city's western waterfront was upwind of most of the city's smoke, in winter or summer. It was an upscale neighbourhood, containing government buildings, Upper Canada College, and the homes of many of the urban elite. Summer winds would blow the smoke from Furniss's chimney into these salubrious districts, and that is probably why the residents complained.

When we group the historic photographs for 1855-1875 together, we can generate a map of urban visibility for the 1860s. We don't have vast numbers of pictures to use, but we probably have enough to plot the visibility in the city's most congested areas. It is fairly clear, however, that the visibility in the downtown core was already quite low, below 250 metres in the area bounded by Yonge, King, Front, and Church streets. Beyond this was a narrow belt of visibility below 500 metres, and beyond that it improved.

Toronto, it seems, already had a smoke blanket, although it was relatively small. But within this small area it was already severe. Coefficient of Haze within the affected area

---

would already be off the scale. The affected district would remain at the centre of Toronto’s smoke blanket for more than a century.

The incipient gloom downtown was beginning to affect the city in other ways. There was sufficient soiling of City Hall and County Hall, for example, for extensive cleaning and painting to be required in 1868. The Globe felt it was sorely needed. And it was a time of notable fogs. One in April 1869 enveloped the city up to the top of the church spires. Others in July 1870 and January 1871 shrouded the bay and city streets. A heavy fog in June 1871 delayed the steamer City of Toronto and stopped it from coming into harbour.

Analysis of the photos for 1865-1885 allows us to reconstruct the visibility patterns of the 1870s. It is fairly similar to the previous decade. The city had grown, but a district of limited visibility remained in the downtown core, similar to the 1860s. It had not extended in size very much, nor had it decreased in intensity.

The idea that the city had a smoke problem was, however, beginning to emerge. In the fall of 1872 and winter of 1873 a body of downtown merchants and property owners in the King-Yonge area petitioned City Council to address the smoke nuisance. Judging from the newspapers, the critics of the smoke nuisance felt it arose from inefficient and inconsiderate combustion. One letter to the Globe blamed the problem on sash factories burning sawdust and shoe factories burning clippings. Another blamed Gooderham & Worts and J P Wagner's planing mill on Adelaide Street East. Mr. Wagner, who was building a 100 foot smokestack complained about unfair press coverage. There is a sense of aesthetic violation, but the critics also noted that it soiled wet laundry and made it disagreeable to open windows in warm weather. There was considerable talk of smoke consuming furnaces but little action, as some of the agitators complained.

Smoke, it seemed, was already a disgrace to the city. “Thanks to the quantity of soft coal being consumed here,” the Globe noted in 1881 “Toronto is fast assuming the grimy look of Birmingham or Pittsburgh”.

The smoke issue resurfaced again in 1878 with an inconclusive attempt to require smoke consumers on the steamboats and, the Globe hoped, industrial plants. "There are times

---

when the streets of the central portion of the city are filled with stifling smoke proceeding from the various large factories, of which there are now a considerable number" the editor wrote.24 In 1881 the Globe itself installed a smoke consumer.25

The critics of the smoke problem in the 1870s were pretty clear about the geography of the city’s smoke issues. The smoke was worst in the downtown core, and the city’s industrial waterfront. Anyone who wished to see the smoke in 1873 “need only take a trip to the Island when a southerly wind prevails”.26

Photography for the 1875-1895 period allows us to reconstruct the visibility patterns of the 1880s. As in the previous decades, the smoke seemed thickest in the downtown and eastern waterfront, but the blanket was reaching further out. It had begun to creep outwards. Moving north on Yonge into the upscale suburbs north of Queen. Beyond this core a few isolated smoke pockets were beginning to appear, as industry emerged along the city’s growing railway corridors.

The 1880s were a decade of transformation in the urban economy. There was new rail construction, and a great deal of consolidation among the lines. The CPR bought up the newly-built Credit Valley Railway (CVR) and thereby entered the waterfront rail corridor as a powerful player. The CPR also added a new east-west trunk line which ran through the suburbs north of Dupont Street. The Northern Railway (NR) converted from broad to standard gauge, while the city's two narrow gauge lines, the TGBR and TNR converted to standard. The Grand Trunk, eager to compete with the CPR, proceeded to double-track its lines between Montreal and Hamilton, passing through the Toronto waterfront.

Corporate consolidation and equipment standardization allowed the city's railroads to amalgamate their services, especially passengers, in a Union Station. Alongside these improvements in transportation was their increasing reach and flow. By the end of the 1880s the new rail lines connected Toronto and its manufacturers to Western Canada.

It was also a decade in which the city’s leadership were forced to acknowledge a growing smoke nuisance. Dr John Cassidy, a leading Toronto doctor, told the Provincial Board of Health in 1883 that a “smoke nuisance was becoming apparent in Toronto”.27 But there was not much medical consensus about solutions or even if it was relevant to human health. The same year also saw a lawsuit for smoke nuisance in Riverdale, which dragged on slowly through the courts in the months that followed.28

A number of complaints reached City Hall about the smoke nuisances of factories, foundries and other industrial plants.29 Alderman Fleming, who owned property in St John’s Ward, complained of a furniture factory behind 344 Yonge Street in 1886. His

tenants wanted to move out because their bed linen had been ruined by the factory’s soot.  

The railways also helped disperse industry and residential growth to outlying districts. Rail corridors in north Parkdale, south Riverdale, East Toronto and especially Toronto Junction became areas of industrial and population growth. The city was gripped by a speculative building boom, which collapsed abruptly in the early 1890s.  

You start to see the effects of the 1880s railway expansion in the visibility patterns of the 1890s, prepared from the 1885-1905 photos. Urban photos begin to become quite numerous in this period, and spread across the expanding city. They reveal a visibility pattern which has expanded greatly from the previous decades. The smoke plume had expanded in the city's core, and out along the north Parkdale rail corridor. Secondary smoke blankets were emerging in north Toronto along the CPR line, and in East Toronto around the newly-established GTR divisional point. Over much of the city visibility had dropped below 750 metres.  

The visibility patterns of the Edwardian period, the 1900s, are based on the numerous photos of the 1895-1915 era. The expansion continued in both the overall size of the city and in its smoke blanket. The Edwardian city was both larger and much more smoky. The central districts and main rail corridors remained at the centre of its smoke geography, but sub 1000 metre visibility now extended over much of the city. Scattered pockets had emerged, in places, of sub 250 metre visibility. In the streets immediately adjoining Union Station it fell below 125 metres at times. A number of smoke 'islands' had emerged in the city's industrial suburbs. They are obvious for Weston, the Swansea waterfront, parts of Dovercourt and East Toronto.  

Photography for the "1910s" (grouping photos for 1905-1925) bring us gruesome picture. This was the decade in which the smoke blanket probably reached its maximum extent and intensity. Apart from some of its suburbs, the city remained under a smoke blanket, and the area of sub-500 metre visibility had expanded. Over much of the city visibility was now below 500 metres, with only the more outlying places escaping with better visibility. Entering the city from the waterfront, visibility dropped dramatically. When the wind was in the south, the city had a smoke wall across the waterfront.  

The visibility patterns of subsequent decades show a gradual contraction of the city's smoke pall, and a reduction in its intensity, while the city continued to sprawl outwards.  

The visibility patterns of the 1920s (based on the photos 1915-1935) show a strong resemblance to the 1910s, but the smoky area is obviously beginning to contract. During the 1920s large tracts of suburban land emerged beyond the smoke blanket, and in relatively clean air. To a considerable degree, the areas of urban smoke intensity correspond to the city's industrial land and major rail corridors.  

---

But by this decade the smoke blanket had probably reached its maximum extent. Beyond it there was a suburban fringe to which it would never spread. Even so, there were still some reductions of visibility. Something of this kind affected the suburbs along Kingston road in Scarborough.

By the 1930s the smoke pattern appears to have contracted significantly. The building boom of the 1920s had allowed the city to sprawl well beyond the rail corridors, and their associated smoke. Smoke intensity remained severe in the inner city and core, and along the rail corridors, but it was in retreat.

The contracting smoke blanket is very evident in the 1940s visibility patterns, prepared from 1935-1955 photos. This was a period of relatively limited suburban growth, except after 1945. The smoke blanket had contracted and fragmented, into three zones of intensity. One was centred on the downtown core and the commercial corridor of Yonge Street, while smoky skies remained in south Swansea and along the East Toronto CNR line. Most of the city, though, was now enjoying visibility considerably better than 1000 metres.

The smoke blanket continued a slow contraction in the 1950s. The visibility patterns for this decade, plotted from 1945-1965 vintage photos show some shrinkage of the city’s smoky heart, but it still extended over a significant area. The city's rapidly expanding suburbs now extended for large distances in all directions and without, it would seem, the kinds of severe air pollution seen in earlier decades.

After the 1950s it becomes difficult to use the photometric technique to map smoke patterns. Some of this arises from the shortcomings of the archives. Toronto's archives are, it would seem, not yet ready to support the photo historians of the 1970s and later. This is a period in which old-style coal combustion had largely disappeared. Petroleum and electricity were the energy choices of the post-war boom. The volume in which they were being consumed was colossal, but it was being achieved without the old-fashioned smoke nuisances. It becomes much more difficult to decipher smoke haze from an archival photograph. We are able, though, to trace the changing geography of Toronto's air pollution by other means.

**Building Soiling**

One of the classic symptoms of urban air pollution was the soiling of specific building exteriors. It was especially obvious in the Coal Smoke Era, and has been widely observed elsewhere. Victorian Londoners, for example, knew that the city's air not only soiled buildings, but also corroded them. Constructing an important building required the selection of suitably resistant stone.

To explore the building soiling issue in Toronto we once more turn to its photographs. This time we need pictures which show the architectural features of buildings and how they discolour over time. Using image processing software (Corel Photo Paint) we can establish the statistics of changes in building tones, and describe their darkening shades.
It is, of course, difficult to guarantee that all photos of a building are taken with the same exposure accuracy, and they were certainly taken with a variety of cameras, photographers, films and light conditions. But if we are patient, order should emerge, and we should see statistical patterns in the variations.

The statistics come from using 256 gray-scale images of the buildings, which the software can handle statistically. We need to select common areas of the buildings, and sample their tonal qualities over time. Photo Paint generates median gray scale values for the areas of the picture selected. These range from 255 for pure white to 0 for pure black.

Over time you see a variety of values for the median gray scale, reflecting differences in lighting, film, exposure, camera and photographer. But the minimal values show an obvious trend. Judging from the results, the city's landmarks got darker over time.

Toronto's 1898 City Hall (now known as Old City Hall) is one of the more commonly photographed structures in the city. It seems to have an obvious soiling curve. We have mentioned how, in the 1890s it started to soil alarmingly during construction. The downtown smoke and soot discoloured its Credit Valley and New Brunswick stone. The soiling curve suggests that between 1900 and 1940 it darkened significantly.

The Cenotaph was constructed on the city hall steps in 1925 and is another frequently photographed landmark. Constructed of a much lighter stone, it soiled much more rapidly that the 1898 City Hall, dropping its median gray scale from 230 in 1925 to 140 by the 1940s. It has apparently got darker since.

The front entrance of University College at the University of Toronto is another long-running feature of the city's photography. In the period 1885-1910 it darkened dramatically, from a median gray scale of 182 to 80. It seems to have reached a plateau of about 50 gray scale in the 1930s and has remained dingy ever since.

Photographic surveys of other buildings are a little more rudimentary, but is clear that several of the city's landmark structures soiled in the 1920s, 1930s and 1940s. Metropolitan United Church, for example, darkened from 195 to 91 between 1930 and 1950. The bank of Commerce Tower [Commerce Court North], built in 1930, darkened from 193 to 167 in the same period. Maple Leaf Gardens, the city's iconic hockey arena, darkened from 201 gray scale units in the early 1930s to 134 in 1960.

This is a scattered collection of buildings, and we might desire a wider survey, but it demonstrates sufficiently that the city's landmarks soiled visibly in the period 1885-1955. Contemporaries certainly noticed the same effect. The Adelaide Street Courthouse, for example, located in the heart of the downtown was cleaned in 1901 of fifty years of airborne grime. "Fifty years exposure to wind, rain, smoke, and dust has blackened the ancient structure". Under the ministrations of a sand blaster it changed from black to cream. Observers doubted that it would have a lasting effect.31 St George the Martyr, one of the city’s more fashionable Anglican churches in 1900, had been built in 1853 in

31 Toronto Star 12 Apr 1901 p. 1.
white brick. By 1904 it was “dingy and weather-stained”. By the Edwardian era the city’s architects had learned to eliminate ledges and other decorations from their designs to reduce soot accumulations.

The worst decades for building soiling were probably those between 1900 and 1940. We have already mentioned the darkening of the Cenotaph, constructed in front of City Hall in 1925. It soiled especially rapidly in the first decade. But something similar occurred elsewhere. Splendid when its stonework was new in the 1930s, St Michael’s Cathedral had darkened to a coal smudge by 1950. Maple Leaf Gardens, freshly built and putty-coloured in 1930, had turned chocolate brown by 1948. Bloor Street United Church was a little deeper into the suburbs, but it darkened somewhat in the period 1885-1915, and rather more by 1955. The Credit Valley stone of the church’s Bloor Street entrance became especially gloomy, while the Indiana limestone remained cleaner.

For most of the Coal Smoke Era it was futile to clean soot off buildings, because it quickly soiled again. But in the later 1950s, with the retreat of the smoke blanket, things began to change. The Bank of Commerce tower was the first major structure to be cleaned, in 1958-9. It was undertaken, it was said, in preparation for the Queen's visit to the city in 1959. The operation was complex and involved high-altitude gymnastics with water and sand blasting equipment. It involved 40 steeplejacks, two million gallons of water and nine miles of manilla rope. Even incomplete, it attracted attention. Metro Toronto used it to promote urban beautification, and the city's clean air campaign. The newspapers took it in as an urban spectacle. The Star noted how cleaning the Commerce tower made the sidewalks gritty, and how it begrimed the Bank of Nova Scotia. Another Toronto icon, Maple Leaf Gardens was cleaned in the early 1960s, and reverted from brown to white-brick beige. Other structures followed this pattern.

The decisive factor in this burst of architectural laundry was the realization that once cleaned, the building would likely stay that way. It was recognition of the very changed nature of the city's air.

Smoke and Horticulture
Clean air is one of the many desiderata of gardening, especially if you want to win prizes in major contests. You also need suitable light, fertile soil, appropriate watering, as well as adequate temperature, and a green thumb. The dedicated gardener can supply most of these, in a greenhouse if necessary, in a congested part of the city. But air quality is difficult to maintain in the presence of severe coal smoke.

32 Robertson 1904 p. 6.
33 Toronto Star 22 Aug 1910 p. 6.
34 Bloor Street United Church Women’s Association 1957.
36 Toronto Star 28 Feb 1958 p. 29.
37 Toronto Star 28 Feb 1958 p. 29.
It depends upon the plants, of course, but many favourites of the Victorians, ferns, palms and orchids, were rather sensitive to SO2. Exposure to the city's coal smoke would therefore inhibit key plants cherished by Victorian gardeners. Those who wanted to grow SO2-sensitive plants, and especially those who wanted to win prizes for them, needed to avoid the worst of the city's coal smoke.

From the 1850s until the 1880s, as we have seen, the area of intense coal smoke was relatively small in Toronto. It covered the city's commercial core, but didn't extend far into the suburbs. Suburban districts, even quite close in, had fairly clean air. They also, it would appear, had numerous garden show prizewinners for SO2 sensitive varieties.

The expansion of the city's smoke blanket, though, changed the situation radically in the next two decades. Garden show prizewinning retreated to the city's outer fringes or its better-appointed greenhouses. In the urban middle ground, the territory engulfed by the advancing smoke, the previous prizewinning gardens were wiped out. Remaining competitors in the smoky area, notably Allan Gardens, showed a distinct tendency to hedge with SO2-tolerant varieties. After a disastrous fire in 1904 it never recovered its earlier reputation.

By the Edwardian period, serious horticulture and floriculture, amateur and commercial, had retreated above the Davenport Hill, or had moved out of town, perhaps to Clarkson or Brampton.

It may seem odd to consider horticulture and floriculture in a discussion of air pollution history, but it matches the visibility patterns quite well, and reminds us that beyond the expanding smoke pall, the clean air retreated.

**Hosiery Holes**

In the spring of 1952 something strange happened to the legs of Toronto's female office workers. The morning of Tuesday 22 April, 1952 was unusually warm (almost 26 °C), with a breeze from the south-southwest. As lunch time approached office-workers' nylon stockings began to fall apart. The phenomenon was most apparent in the downtown financial district, on King Street between Yonge and John. The *Globe* despatched a bemused reporter to look into the matter. At North American Life eight out of twelve women had torn stockings, and twenty out of thirty at the *Globe* itself. Outside on the street the calamity was less apparent, with only one in five women at King and York sporting torn hosiery, but the hosiery stores in the downtown area did a brisk business that lunchtime.  

It wasn't snags which had caused the failures. Stockings then, as now, were vulnerable to routine tears, but these went beyond the normal runs. The women who wore them were experienced users and knew their normal hazards. On that April morning the stockings tore in strange new ways, and in new places. The problems were not confined to hose, as the *Toronto Star* noted. Holes and tears appeared in nylon stockings, blouses, and what

---

the Star delicately described as "other clothing". Anything made of nylon, it seemed, had begun to disintegrate.

What had caused the catastrophic failure of Toronto's hosiery? Some of the stenos suggested that it was related to the atmospheric nuclear bomb test at Yucca Flat the previous day. It was rapidly realised, however, that it was a consequence of air pollution. Nylon is vulnerable to chemical attack from both the oxides of sulphur and those of nitrogen. Ozone plays a role too. In the polluted 1950s Toronto's downtown had an abundance of these atmospheric chemicals.

The oxides of sulphur resulted from the burning of bituminous coal, fuel oil and gasoline, oxides of nitrogen came from the burning of petroleum, particularly gasoline. The city was gradually shifting from the air pollution patterns of an age of low efficiency coal combustion, to those of an age of petroleum. In April 1952 it had the worst of both.

This was the first well-publicised incident of its kind in Toronto, and it wouldn't be the last. But the problem had occurred before, on a smaller scale, and was already known to Toronto's women. As a teenaged office worker arriving in Toronto in 1946 my mother-in-law learned to protect her precious nylons from the ravages of auto exhaust. Her friends told her that it was unwise to stand too close to auto fumes as you waited for the St Clair streetcar. If a car got stuck waiting for the light to change, you stood back to save those important still-rationed stockings.

By April 1952 and Toronto's incident, large-scale hosiery failures had already happened elsewhere, notably Philadelphia and New York City. These reflected urban air conditions, but also the formulation of nylon. Nylons were essential office wear for women in those more conservatively-gendered times. Every woman from the steno pool upwards was expected to wear skirts and nylons at the office. In April 1952 we therefore had a "perfect storm" of polluted air and the widespread use of a type of nylon vulnerable to the toxic brew drifting on the southerly breeze.

The Hosiery Incident of 1952 entered the colourful folklore of the city's air pollution specialists. The tale was told and retold for the next couple of decades, until the reforms of the 1970s dissipated the SO2. Harry Belyea, Metropolitan Toronto's Air Pollution Commissioner was the tale's chief raconteur. The Hosiery Incident became a standard feature of his many professional speaking engagements. In February 1957, for example, he took the tale to the Metropolitan Toronto Civic Conference. The runs in hosiery, he said showed why the city needed tighter air pollution controls. Through the 1950s and 1960s Belyea regaled visiting newspaper reporters with edifying war stories of ruined stockings. When the Globe covered a nasty smog episode in October 1957, for example, the ruined stockings were recalled. When Toronto businesswomen met in convention a

---

42 Toronto Star 29 Apr 1952 p. 6.
few days later, Belyea urged the need for smog control and reminded them of the Hosiery Incident. They seem to have been an appreciative audience.\textsuperscript{46}

The Hosiery Incident went well beyond amusing anecdote and folklore. In the aftermath of the October 1957 smog, Belyea actually sent out his inspectors to examine stockings. His officials were told to supplement their instrumental tests and Ringelman charts by discreet reconnaissance of women's legs. Belyea also began adding stockings to his instrumental system. In November 1957 he had his technicians install racks of knee-highs and other forms of female legwear alongside his dust jars and athelometers. For a few short months stockings helped monitor the wretched state of the city's air. Reinforced nylon toes pointed skywards from the city's rooftop measuring stations. Like the sacred geese of ancient Rome, racks of ecru nylons stood guard over Toronto, warning it of atmospheric danger.\textsuperscript{47}

Episodes of hosiery failure continued, prompting Toronto's women to send Belyea their distressed stockings. Others phoned in complaints, especially it seemed when SO\textsubscript{2} was at elevated levels in the urban atmosphere. Harold Belyea was still pursuing his professional stocking fetish a decade later. When he was interviewed by the Globe in 1966 he had, conveniently on hand, a pair of freshly-ruined stockings from a city-hall staffer who had rashly tried to sunbathe on her lunch hour in Nathan Philips Square. Sulphurous waftings from the Hydro plant at Pearl and Simcoe had done their awful work.\textsuperscript{48}

The failure of Toronto's nylons illustrated some of the problems of air pollution in graphic fashion. It helped Harold Belyea explain why his work was important. It showed the hidden dangers of the chemical soup which people were breathing, but the real issues went deeper than amusing anecdotes. As \textit{Toronto Star} editorials put it if "Toronto's polluted atmosphere constitutes a hazard to nylon clothing" and if "smog particles eat holes in nylon stockings and blouses", "what happens to people's lungs and throats?"\textsuperscript{49}

\textit{Photochemical Smog}

The term "smog" was coined in 1907 to describe an atmospheric haze in which dispersed smoke and fog intermingled. We now associate the term with the photochemical smog of the automotive era. In this type of smog petroleum emissions are transformed by sunlight into new, unhealthy compounds. The oxides of nitrogen emitted by internal combustion engines are the main chemical feedstock. Autos burn gasoline, but also emit partially or unburned portions of fuel from their tailpipes. Some NO\textsubscript{X} emerges from coal-burning systems, even high efficiency ones, but the proportion is usually low. Classic photochemical smog is therefore an aspect of the automobile age, with its abundance of gasoline engines. While auto emission controls began to reduce the output of smog ingredients emerging from individual vehicles from the 1970s, a steady increase in

\textsuperscript{47} [Toronto] \textit{Globe & Mail} 2 Nov 1957.
\textsuperscript{48} [Toronto] \textit{Globe & Mail} 10 Jun 1966 p. 5.
\textsuperscript{49} \textit{Toronto Star} 24 Apr 1952 p. 6; 29 Apr 1952 p. 6.
gasoline consumption has wiped out many of the gains. We are still trapped in the age of photochemical smog.

Toronto media sources began referring to smog in the 1940s, while coal smoke was the key symbolic air pollutant. Wartime conditions curbed the use of gasoline and fuel oil, and probably reduced the NOX emissions. During the later 1940s and first half of the 1950s discussions of Toronto's smog remained firmly within the coal smoke paradigm. Experts and lay people alike discussed the city's air problems, and its smog, as coal-smoke derivatives. Reduction of low-efficiency coal burning, plus a shift to petroleum fuels were treated as smog-reducing strategies.

At some point in the mid 1950s, though, expert opinion began to acknowledge the shortcomings of petroleum fuels. The clearest statement of this situation came in a 1956 interim report of a Select Committee of the Ontario Legislature. Known in the Toronto media as the "Smog Committee", it had been set up in 1955 to enquire into the best means of managing the smoke nuisance in Ontario. Its interim report followed past practice of blaming coal for most of the problem. Coal, it said, was responsible for 70% of the smoke problem, but auto emissions represented 30% and the amount was "creeping up".50

Experts from this point onwards, and increasingly the laity, began to attach greater significance to auto emissions in discussions of Toronto's polluted air. Within four days of the Smog Committee's interim report, Metro Toronto's ballooning vehicle registrations were being blamed for the city's rapidly rising cancer rates.51 Within a month articles and editorials had appeared in the Globe blaming Toronto's smog on auto exhausts and condemning the "perverse halo of smog which crowns downtown".52

When the Select Committee produced its final report in February 1957 it was quite clear that auto exhausts were deeply implicated in smog. Auto tailpipes, along with garbage incinerators were identified as major air polluters.53 The polluting nature of auto emissions was becoming acknowledged and well established.

Another strand in the emergence of photochemical smog was a shift in the seasonal patterns of air pollution. In the classic coal smoke era the worst air conditions seems to have been in the heating season. The summer was a period of comparatively clear skies, although the smoke continued downtown, and along the railway corridors. Photochemical smog, on the other hand, develops best in warm summer weather, when strong sunlight is available to affect pollutant chemistry.

Despite rapidly rising motor traffic, it is fairly clear that summer smog conditions were not severe in the 1920s and 1930s. Outside Toronto's downtown core and rail corridors there were few summer smoke complaints of any kind before 1940. Most suburban

51 Toronto Telegram 20 Mar 1956.
complaints about smoke, unless connected with railways, occurred in the heating season, along with most of the respiratory deaths.

The newspaper coverage of Toronto's air pollution began to shift in emphasis after 1940. Smoky and smoggy episodes continued to be attributed to coal, but discussions of the city's general smoke haze occurred increasingly in summer. Increasingly too, these discussions made reference to the terminology of smog.

During the early 1940s Toronto people read about summer smog in Edmonton, Pittsburgh and St Louis, but they also read about it more locally. J. V. McAree, for example, used his Globe column to deplore Toronto's summer smog in 1946. It was visible, he said, to inbound aircraft for miles in each direction.

Summer smog became more obvious in Toronto during the early 1950s. On 17 July 1953, for example, the city core was shrouded in a choking summer smog. It covered the downtown, and darkened city streets. Officials blamed it on the heat, the humidity and the steam railways. Another major smog occurred in early July 1955. Four days of smoggy conditions generated a surge of complaints to the city's Smoke Abatement office. More telephoned complaints had come in those four days than were normally expected in six months. Officials blamed the smog on the summer heat.

The most noteworthy smog of the 1950s, however, occurred not in high summer but in mid-October inversion conditions. After three foggy days in October 1957, large amounts of smoke had been trapped in the stagnant air under an inversion layer. The worst day was 16 October 1957 when SO2 levels at the Etobicoke sampling point reached 1.2 ppm, twice the previous station record. This was only slightly below the 1.4 ppm of SO2 registered in the London UK killer smog of 1952. The coal-burning Hearn generating station was blamed for much of the SO2, but important contributions were made by the city's 500,000 domestic furnaces and 400,000 motor vehicles. While the press condemned the smog and called for action, Metro Toronto designated the next few days (20-26 October 1957) as a "clean air" week. Another grimly smoggy episode followed on 17 April 1958, in which Queen's Park disappeared into the urban murk.

By the 1960s summer smog had become fairly routine in Toronto and was ceasing to attract much attention. But dwindling press interest did nothing to curb the severity of the problem. The smog on 20 August 1964 was enough to obscure the clock at old city hall. Hidden from pedestrians, it would have escaped the printed record too, but for a letter to the editor. Diminishing interest may be connected to the changing nature of the pollution. In the classic coal smoke era smoke was highly visible, and all of the local

54 Toronto Star 3 Sep 1940 p. 9; 26 May 1945 p. 5; 11 Jun 1946 p. 4.
57 Toronto Star 8 Jul 1955.
municipal regulation was based on visual criteria. Ringelman smoke charts, athelometers, Thomas autometers, and dust jars were deployed to instrument and measure the city's polluted air. Chemical analysis was limited. Metro had only one machine to measure SO2 in the later 1950s, and no means of sampling NOX or VOC at all. The photochemistry of smog, its hidden chemical components remained obscure. Visual criteria remained primary in most discussions of smog. Pierre Berton, writing in the Star during the summer smog season of 1961, for example, thought that Toronto's smog problems were easing. Over the past decade, he said, the nuisance of airborne smut and soot had considerably reduced.62

In fact, as the science of air pollution was beginning to recognize, the dangers of chemical pollutants remained, despite the reduction of visible soot. The hidden chemical dangers loomed large in a January 1963 meeting of the Air Pollution Control Association. Dr D. C. Little drew a strong connection between rising rates of lung cancer and the hidden air pollutants.63 Dr. A. R. J. Boyd, Toronto's Medical Officer of Health agreed with him.64 Later that year the city's Board of Health blamed rising lung cancer rates on urban air pollution.65 Commissioner Belyea absorbed these ideas and by October 1963 was expressing them as established expert opinion. Urban air, he said, caused lung cancer, asthma, and bronchitis.66

Discussion

It seems fairly clear that air pollution has both a history and a geography in Toronto's past. Although we can't map it easily before the 1850s, the city's air pollution problems can be traced back into the wood smoke era, and had become substantial by the city converted to coal. The city's commercial core vanished under a smoke blanket during the 1850s and doesn't seem to have emerged until the 1960s.

Alongside the development of the city, and its maturing space-economy, the smoke spread and intensified. The pace of change accelerated with the rail developments of the 1880s, intensified in the 1890s and 1900s before peaking in the late 1910s. With something of a plateau in the 1920s, the smoke blanket contracted and fragmented from the 1930s, although it remained strong in the downtown core until the 1950s. We can see from the pattern of building soiling, and the curiosities of horticulture, that the smoke blanket was dynamic in character, and devastating in its effects.

From the texture of the smoke, we are conscious of the important anchoring role played by rail corridors and their associated industries. These were the districts where the largest amounts of coal were burned and the most smoke was released. Residential areas used most coal for winter heating, while railway corridors and industry burned coal year round, for process heat and steam.

64 *Toronto Telegram* 22 Jun 1963.
65 *Toronto Telegram* 19 Sep 1963.
The growth of the smoke blanket was accompanied by the emergence of suburban areas placed beyond it. The configuration changed as the smoke advanced, but in the 1880s and 1890s we find south Parkdale, Rosedale, the Annex and the Beaches emerging in the clean air beyond the smoke. In the 1900s and 1910s we see Davenport Hill, High Park, Swansea and North Toronto emerging as the smoke expanded.

The changing geography of smoke was very much connected to the changing combustion patterns of the city. The great expansion in the smoke blanket is intimately linked to the development of the low-efficiency combustion of coal, and its retreat is connected to the emergence of an economy addicted to petroleum and electricity (much of which came from high-efficiency coal combustion).

The deployment of the "Smokeless" combustion regime was not characterised by an old-style coal smoke blanket, although it burned much more coal than the city ever had in the 1910s. The new regime seemed cleaner, although it quickly developed problems of its own.

Before 1960 it is fairly evident that the city's air pollution was acutely noticeable. Ordinary citizens were aware of the smoky essentials of its geography. People might overlook the CO2, but they noticed the soot, the smell, the dust and the smoke. The geography of the city's post 1950 photochemical smogs was more difficult to define. Visibility was affected, but perhaps less than formerly. People noticed when urban air conditions were bad, but had difficulty sensing its geography and the strategies for avoiding it.