章節6：在烈日下：都市熱浪

引言

長期居民將知道，多倫多夏天會很熱，令人不舒服。熱浪之夜會很暖和，令人粘稠，而白天則會帶來一種灼熱的組合，蒸霧熱浪和霧霾。而且預計全球暖化的情況會變得更糟。

雖然城市史學家有時會忽略它，但多倫多的夏天熱浪有著長長和重要な歷史。它也具有複雜的地理學。在長久的時期裡，多倫多熱浪的地理變化幫助重塑了城市及其周邊地區。都市熱浪在它的生物物理史中扮演了重要的角色。

如果我們要組織一次田徑之旅，讓都市史學家見到過去的熱浪幽靈，我們可能會在1921年7月初開始。那些在追求生物物理壓力的人將發現多倫多在典型的酷暑天氣中悶熱。天文台，負責官方溫度記錄的官員，將最高溫度定為 93 °F (33.9 °C)1 但實際上它在城市的工場中要暖和得多。市中心的辦公室在90年代中期左右，而餐館、窯院、造幣廠，和氣體廠的溫度則高達100度。2 工作場所的職員普遍缺席。

熱浪關閉了西頓的CCM工廠，並減少了達納普橡膠的員工。Gurney和Pease的造幣廠關閉。石膏匠和砌磚匠放棄工作。3 人們在工作時把頭探出車窗尋找微風。4 而那些不上班的居民則在城市的公園或浴場找到陰涼。5 百萬人涌進城市的浴場，6 多數人都會在熱浪中過夜。7 因為熱浪使得白天的熱浪在公園和浴場造成水荒。8 顧客會避開肉舖和餐館9，懸念的是， GAMERS和NIGHTMARE的零售商，10 但是卻會向賣光線服裝的零售商拜訪。11

在全市，人們在熱浪中倒下。兩位年輕女士在科學博覽會的書房被熱浪摧毀，12 鑽石大樓的一位女僕在走在去郊區工作之前，13 一位猶太婦女在清潔伊麗莎白街的家時倒下，14 而一位猶太婦女在清潔伊麗莎白街的家時倒下，15

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研究

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baker worker collapsed at work. Elderly men and women keeled over and died on the street. The heat killed a young housewife and a grizzled old teamster.

Horses suffered alongside the city's human inhabitants. Five collapsed in one day on The Danforth alone. As the hot weather continued, the City Dairy lost one horse a day, as did the city's ice wagons. Nine horses at the Don Valley brickworks died in one day, before the teamsters refused to take out the rest. People brought overheated animals to the Humane Society, 12 dogs and 40 cats one day, and nine stricken horses the next. To save the city's working horses, each householder was asked to place a water bucket on the lawn.

As the city adapted itself to warm conditions, loosening its collars, and opening its windows, official and judicial authority endured with dignified indifference. The police and postmen continued to wear their heavy serge uniforms despite street surface temperatures in the 110s. Presiding in the 90-degree heat of courtrooms judges refused to admit witnesses unless suitably coated, with collars and cuffs properly fastened. If the heat-wave continued through the weekend there would be no relaxation of the rule that soda fountains, ice-cream parlours, and playgrounds be closed on Sundays.

Toronto in 1921 was a city almost entirely without air conditioning. Even in the wealthiest homes, there was no refuge from the heat beyond a little shade and an electric fan. Few people had electric refrigeration. A heat-wave brought dramatic changes to the city. The weather that July was unusually hot, but the city had seen hot spells before, and would certainly see them again. People knew the routine.

Toronto's wealthy avoided summer heat by taking vacations, or by going to the beach or park. Many of them left town for the summer. If they stayed behind, their suburban homes were surrounded by shade trees, verandahs and sleeping porches. They had summer wardrobes, summer kitchens, and lawn furniture. Their homes were located in the cooler parts of town. They belonged to social organizations which offered summer picnics, they took excursion trains and steamers. They motored and bicycled to seek fresh air on summer weekends and evenings. Some of them would send their children to summer camp, or would take their families out of the city to a resort or cottage.

Most could not afford these luxuries. In the city's poorer quarters tens of thousands faced the hot summers without get-out-of-town vacations. Serving the curse that pinned them down, they endured the heat without shade, refrigeration or ice-cream. Heat brought suffering to their taken-for-granted world.

14 Toronto Telegram 6 Jul 1921 p. 13.
15 Toronto Telegram 7 Jul 1921 p. 13.
16 Toronto Telegram 6 Jul 1921 p. 13.
17 Toronto Star 7 Jul 1921 p. 2.
18 Toronto Star 8 Jul 1921 p. 2.
19 Toronto Telegram 6 Jul 1921 p. 13.
20 Toronto Telegram 5 Jul 1921 p. 13.
21 Toronto Telegram 7 Jul 1921 p. 13.
It is perhaps no surprise that Toronto's people responded to extreme heat socially, enmeshed as they were in the differences of gender, class, age, ethnicity, and occupation. Some could afford to avoid the heat, but most had no choice but to endure it. But there was also a fundamental geography which underlay these responses. As the people well knew, Toronto was warmer than its rural surroundings. Within this warm city, the downtown was warmer still. Toronto was experiencing the discomfort of what climatologists call a heat island.

**Background on the urban heat island**

Luke Howard was the first to notice that cities had higher temperatures than the surrounding countryside. London in the 1810s was not only a little warmer than its surroundings, it also seemed more prone to fogs. Air pollution probably played a factor in Howard's 'city fogs', but so did urban temperature. A few decades later, during the 1850s a French scientist, Emilien Renou spotted a similar effect in Paris. Like London, Paris also seemed to be warmer than its rural surroundings. Over the next century these observations were repeated in a number of major cities, from St Petersburg to San Francisco.

The urban heat effect, according to theory, results from passive solar heating of urban structures, mainly buildings. During the day they absorb and re-radiate heat, elevating daytime temperatures and warming the urban night. Heat is stored in the city's thermal mass, its brick, stone, concrete, asphalt, and steel. Additional heat contributions are made by pockets of air trapped inside buildings, unable to radiate to the sky, and by the heat sources common in urban structures. These include furnaces, air conditioning vents and so on. The roughness of the built-up urban surface also tends to trap warm air and hold it in place despite cooling winds.

The urban heat effect can obviously raise daytime temperatures, but its classic effect is to increase night-time temperatures. It is supposed to be most noticeable in the winter, on nights which favour radiational cooling, but it is found at other times as well. One researcher, looking at Calgary's heat island in the mid-1960s, showed it existed throughout the year, day and night, although changing shape and size according to weather conditions.

The term "urban heat island" was adopted to describe the urban heat effect at a time before satellite-based observation of temperatures. The first generations of heat effect investigators had to consult ground stations supplemented by traverse surveys. Starting in Vienna in the 1920s, researchers undertook temperature traverses by car, bicycle and even streetcar. The great classics of the field were characterized by intrepid feats of urban driving. One has visions of T J Chandler scuttling across the gloomy landscape of London on dark February nights in the 1950s, frantically collecting temperatures from his Austin Seven. (At least, I like to think it was an Austin Seven). Toronto joined the craze

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23 Emilien Renou (1862) "Differences de temperature entre Paris et Choisy-le-Roi" *Societe Meteorologique de France* 10: 105.
24 Yukovich 1967
too, and in 1935-6, one of Canada's more dedicated instrumental meteorologists, W E K Middleton, drove temperature transects up Yonge Street, from the Lake to Willowdale.

A critical moment in urban climatology came when these scattered observations of the urban heat effect were mapped for the first time. The classic research was done in London by Chandler in the later 1950s. Using a combination of ground stations and temperature traverses, he was able to construct a temperature map of the city. Some parts of the map were rather speculative, with hopefully-placed dotted line isotherms, while others were more accurately measured. Temperature, Chandler showed, made a pattern like an onion cut in half. The core of the city was measurably warmer than the suburbs, with gradations in between. The phrase "urban heat island" was subsequently coined to describe the phenomena. A flurry of follow-up research ensued, and urban heat islands were found almost everywhere that researchers cared to look. Canadian cities were mapped also, notably Winnipeg, Montreal and Calgary.

One of the features which emerged from the research was that North American cities display much more strongly-defined heat effects than those of Europe. Howard and Renou, for example, had noted urban heat effects of around 2 °C in London and Paris. These cities were population giants of their day, well above a million each, and closer to two, but their heat islands were only modest in scale. In North America, as T R Oke has pointed out, cities generate significant urban heat effects at much smaller populations. Large North American cities have much bigger effects than similar-sized European ones. Some of this may be climatic, but most likely it is related to geographical differences in city density and layout. North American cities tend to sprawl much more than their European counterparts.

According to theory, the urban heat effect arises from the built environment. It emerges from its storage of solar heat, its heat source emissions, its rough surface topography, and its trapped air. It should exist in any size of urban centre, in any location and in any time period, provided the urban materials are sufficient to support the phenomenon. We should expect the urban heat effect to exist throughout urban history, and in every part of the world. But few historians have bothered to look for it. Apart from a few once-contemporary studies which have now matured into the "historic" category, we have very few investigations of the urban heat island prior to the 1960s. So far, nobody has attempted to reconstruct the heat islands of the urban past. This is despite an abundance of urban meteorological data.

This situation arises because the history of urban climate falls into the gap between two very different disciplines. Climatologists, who are the experts on the science of climate, are generally not historians. They don't do research in urban history. Urban historians don't deal with climatology. As a result nobody seems to be doing archaeometric reconstructions of the heat islands of the urban past, and nobody has shown how they change over long periods of urban history. The thermal geographies of the urban past are unexplored landscapes, patches of terra incognita in otherwise familiar cities. More remarkable is that this ignorance exists in an age desperate for information about global climate change.

25 Einarrson and Lowe 1955, Summers 1964, Yukovich 1967
climate change, and in which most people live in cities. It is time that a serious attempt was made to investigate the historical geography of urban climate.

Establishing the existence of a heat island in Toronto

We should start our investigation of Toronto's heat island by consulting the best statistical data. Fortunately, the city has one of the longest-running temperature records in Canada, starting in 1840. Known by various names, and managed by various agencies, a weather station, established on the University of Toronto campus provides us with details of the city's temperatures for the period 1840 to the present.

One of the most widely-used techniques for detecting an urban heat island is to look at the differences between average maximum (T-MAX) and average minimum (T-MIN) temperatures, the so-called dynamic temperature range (DTR). Researchers look not just at overall increases in temperature, but especially at relative increases in minimum temperatures (T-MIN). Since the heat island is noted especially as an increase of minimum temperatures, a relative increase in these (and corresponding weakening of the DTR), is a sign of the urban heat effect.

July is the Toronto's warmest month, and when we graph maximum and minimum July temperatures, we notice a steady increase in T-MIN from 1840 to 2000, while T-MAX rises more gently. The DTR, a measure of their relative positions rose gently 1840-1905 and then began to fall (Figure DTR July). William Gough, a Toronto climatologist argues that the reduction of the city's DTR from the early Twentieth century is a clear sign of a developing heat island. He estimates from the changes in the DTR that the city developed a 5 ºC heat island in the period 1920 to 2000.

T-MAX, T-MIN, and the DTR are all measures of average temperature, but they are not the only ones available. We also have data for the "degree day" temperature aggregates. These are used to compute the heating or cooling requirements of the city, and are based on a benchmark of 18 ºC. Mean daily temperatures above 18 ºC indicate a cooling requirement, and below that indicate a heating requirement. Usually these are aggregated and quoted on a monthly basis.

Graphs of Toronto's July degree cooling days show a rising trend, which possibly extends from 1840 onwards (Figure DD July). There are wide fluctuations from year to year but the increase becomes more rapid after the mid 1880s. In the period 1840-1880 the city averaged around 70 degree cooling days in July. In the most recent 40-year period, 1960-2000 it averaged 130 degree cooling days. The Julys of the later Twentieth century were therefore much warmer than those of the mid Nineteenth. Between the two eras the city's July cooling requirements approximately doubled.

Turning our attention to the winters, which helps round out the issue of the urban heat effect, we notice that the city's T-MAX, T-MIN, and DTR patterns broadly echo their July counterparts (Figure DTR Jan). Most notably the T-MIN values rose from the early 1900s, when they averaged around -12 ºC to the later Twentieth century when they averaged -6 ºC. The winter degree heating days show a trend downwards from around
1900 to the present. The early 1900s Toronto had around 700 degree heating days in a typical February, versus around 575 today (Figure DD Jan).

To summarise these various data, the records seem to show that Toronto's winter heating needs decreased significantly over time, by around 15% in February, during the Twentieth century. By contrast, the summers became warmer. The typical Toronto July today has a cooling requirement 1.5 times larger than the typical July of the mid-Nineteenth century.

Based on the DTR, Gough and his colleagues claimed a heat island for Toronto emerged around 1920 (they were using 5-year averages, so the inception might be a little earlier). Another researcher, Aston, using mean temperatures thought that the urban effect began in 1900.26 The July cooling degree data, however, suggests that we may be able to push back the inception of the heat island into the mid 1880s.

**Mapping the Twentieth-Century Heat Island**

The wonderful runs of climatic data collected by the Observatory and at official weather stations across the urban region allow us to identify a heat island. We can be fairly certain that Toronto had a heat Island from the early Twentieth Century, and we can express aspects of its growing strength.

These are somewhat limited observations. The weather station data gives us graphs and their derivatives, but they show us nothing in map form. Through these data we can imagine a heat island slowly gaining strength, but we have no clear sense of what it looked like on a map. These data would probably be useful in making a map, but we will need more information. To make maps we need arrays of observations coming from different parts of the city. The data need to be simultaneous, or nearly so.

Fortunately, these data exist, and for brief snapshots of time. They come with the limitation that they were recorded in connection with extreme weather, deep winter cold or torrid summer heat. But they exist. These data have seldom been used by historians or climatologists, but the sources are readily accessible. Once again we turn to the region's historic newspapers.

Populist newspapers were a major feature of Toronto's early Twentieth Century print journalism. Their journalists turned to the city, its neighbourhoods, its suburbs and outlying districts for both customers and news material. The Toronto Telegram, for example, had networks of local correspondents, feeding in local stories, attending ratepayers' meetings, council proceedings and the magistrate's court. They reported on church socials, stolen bicycles, industrial accidents and amateur cricket matches. When weather made the news, they reported on the local conditions. Thermometers were widespread and temperatures were easily stated. Out of local reports the newspapers could fashion their city-wide coverage of a heat wave or a cold snap. In some periods the newspapers reported on the temperatures of the bathing beaches. Each newspaper had its own correspondents, and these had their own sources of temperature data. The *Toronto*  

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Telegram, for example, had institutional linkages to the Lakeside Home, the summer pavilion of the Sick Children's Hospital. Telegram stories of summer highs and winter lows, therefore, reported its temperatures. In many cases of extreme weather, we have coverage in several newspapers, allowing a more complete picture of temperature patterns. The records of the Observatory and the other official weather stations add further detail.

Pulling together all the various sources, therefore, we can find spatial arrays of urban temperatures: data we can map. The data come as point observations, but it is easy to turn these into isotherms, or temperature contours.

The earliest reconstruction we can manage comes from overnight lows in the winter of 1908 (Figure 1908). Winter overnight lows have the advantage of being shade temperatures, by definition. The grid of observational points is thin, but sufficient to show a distinct urban heat island. The suburbs were cooler than the thermal core of the city, centred on the downtown. The overall temperature contrast, the Delta-T was something in the order of 2.5 °C. I doubt though if people were complaining about the heat, in those wintry temperatures. The heat island extended over pretty much the whole of the contemporary built up area. This is the earliest heat island I can construct for now, and is earlier than any I have seen in the scholarly literature.

We can construct another heat island map for the winter of 1910 (Figure 1910 W). The pattern looks a little different from 1908, but we must allow for some variations. In many respects it is a similar pattern. The heat island strength is about the same, with Delta-T being 2.5 °C again, and the downtown is still at the centre of the city's thermal patterns.

July 1910 gives us the first of the hot-weather patterns (Figure 1910 J). This is based T-max, the daytime high. From what I can tell these are shade temperatures. The pattern seems a little different in detail from the two winter patterns of this era, but Delta-T is about the same and the thermal pattern is still centred on the downtown core.

The next reconstruction we can manage is for the heat wave of July 1921 (Figure 1921). It is incomplete, and we only have temperature coverage for part of the city. Delta-T is around 4 °C. The downtown is still a temperature peak, but the pattern is made more complex by significant lake effect. When this occurs the city is a little cooler than the districts inland.

A more complete reconstruction for June 1925 reveals a city which has sprawled outwards much more than in Edwardian times (Figure 1925). The thermal core is still centred on the downtown, and delta-T is 3 °C or so. There is a sense, though, of a larger zone of raised temperatures, enveloping the bulk of the expanded city.

Sprawl continued in the 1920s and in July 1936 the heat island extended over a large area (Figure 1936). Delta-T was around 3 °C, but the zone of elevated temperature had increased over 1925.
Changes in newspaper reportage and local press coverage make it difficult to reconstruct heat islands in the 1940s, 1950s and 1960s. The newspapers ceased to report suburban news in as much detail, and generally ceased to report on local temperatures.

I have managed to build a heat island map for February 1955 (Figure 1955). Based on overnight lows, it confirms the familiar picture of a city with a thermal core centred downtown. Urban sprawl was now very extensive, and the pattern reached outwards over a large territory.

This sequence of maps shows us Toronto's heat island evolving over a reasonably long period of time, from 1908 to 1955. The patterns vary seasonally, over time, and according to local weather conditions. Several trends are apparent.

By about 1910 Toronto's heat island already displayed the main features of its early Twentieth Century configuration. The warmest parts of the city were downtown, and the temperature gradient dropped outwards in all directions. It fell very abruptly towards the lake (the lake effect) but it also faded toward the suburban fringe. The Yonge Street corridor was the most important north-south lineation, taking the edge of the heat island as far north as Eglinton. The east-west extent of the heat island occupied the remaining airspace over the old Iroquois lake bed. Like the city, the heat island was spread by east-west corridors such as Lake Shore Road, Queen Street, Bloor and to a lesser extent St Clair Avenue. In extreme summer temperatures, a hot day or a hot night, you could expect a 4 °C ΔT between the downtown and the heat island's outer limits.

We have noted how the hot weather ΔT increased markedly in the period after 1900, and it is no surprise that the area affected by the elevated temperatures also increased. If we think of the territory where the ΔT exceeded 2 °C, then this 'thermal core' was 21 km² in 1911, around 33 km² in 1921 and around 50 km² in 1936 (Figure HI area).

On the whole, the thermal core tended to expand more in an east-west than in a north-south direction. In 1910 the area within ΔT >1 °C stretched from High Park in the west to the Beaches, but by 1936 it extended from the Etobicoke lakeshore to the Scarborough Bluffs. Despite significant urban overspill north of St Clair Avenue, the thermal core expanded only modestly up Yonge Street. Between 1910 and 1936 it advanced from Eglinton Avenue a little closer towards Lawrence Avenue. Modifying the 1936 pattern was the emergence of suburban hot spots, notably in the Weston/Mount Dennis area, a dense industrial suburb, but also on the Etobicoke Lakeshore, and in some of the north Toronto suburbs.

Over time, Toronto's heat island strengthened. In the Edwardian era delta-T was in the region of 2.5 °C. In the 1920s and 1930s it had reached around 3 to 3.5 °C. William Gough and his collaborators put the figure today at around 5 to 5.5 °C. When we graph these values, a trend is apparent, strengthening from Edwardian times onwards.

If we look at the area affected by the heat island, we see another increase over time. A slight recalibration allows us to express the heat island in terms of delta-T, measured
from the centre. These measures have to be approximate, and are based on where I have placed the isolines. The graph shows, however, increases over time in the urban area entailed by at least 1 °C of heat island, and corresponding increases in the areas of 2 °C of heat and so on. Over time, more and more of the urban area was getting warmer.

We can go further than this. The analysis of official weather records points to a heat island which emerged in the early Twentieth Century. Gough suggests the 1920s, Aston around 1900. But our heat island maps begin around 1910 with a delta-T of 2.5 °C. This is no small value. Edwardian Toronto already had a mature heat island, something which had probably taken decades to develop to this point. It is an important clue that the city's heat island must begin much earlier than the climatologists have suggested.

If we try a simple extrapolation of the delta-T from our heat island maps, then we can project a simple linear trend backwards in time. It cannot be reliable, but it suggests that delta-T might have become detectable in the 1860s, and that a recognizable heat island might have emerged in the middle of the Nineteenth Century. This would take us back to the building boom of the early railway era. But it is only an extrapolation.

**Reconstructing temperature history downtown**

To reconstruct the nineteenth century thermal geography of the city, we need to look at the temperatures being recorded in the downtown core. The Observatory, with its long runs of data, was never really at the thermal centre of the city. Established in 1840 in a park-like setting on land set aside for a provincial university, it lay outside the built up area until the 1880s. After that time it slipped inside the urban envelope, captured by the city's sprawl, and possibly compromised by its heat island. The park-like surroundings may have buffered it, it is difficult to say. Despite its long runs of careful observations, it never measured the temperatures of the city's thermal core, although it sometimes measured its rural surroundings. To probe Toronto's Nineteenth Century heat island, we need to investigate its downtown temperatures.

Domestic thermometers and barometers were a stock item of dry goods retailers across the Victorian world, including Toronto. It is difficult to estimate their number in the city, but they were surprisingly widespread. We may expect thermometers to have been kept by stationary engineers, and at the gas works, but they were also a widely-owned item for the broad middle class. Lawyer and gas company executive Larratt W Smith had a portable thermometer which he consulted four times a day, recording the temperatures in his diary. He carried the instrument around with him, to Muskoka, to Europe, to New York or wherever business of pleasure took him. The urban temperature historian might wish that he had taken it to work occasionally, but when he was in Toronto he mostly kept it at home, within arm's reach of his diary. He recorded indoor and outdoor temperatures on rising, and the same again before he went to bed. Compared to the Observatory, he was quite accurate, somehow managing to trap daytime highs and overnight lows which matched the city's official temperature record.

Thermometers were certainly a feature of the city's downtown streets, and graced the façades of several of the city's better stores. There were several displayed on the most
fashionable shopping strip, King Street east of Yonge. One of the more commonly consulted ones was on the façade of Judah Joseph's jewellery store in the 1860s and early 1870s. His store was on the south side of King, which would mean that his thermometer recorded shade temperatures in the hottest part of the day. Joseph, a leader of the city's nascent Jewish community, was also the city's leading instrument maker, selling and servicing the transits of the city's engineers and surveyors from the 1840s onwards. His thermometer seems to have been quite effective, with a succession of plausible readings, without the absurd fluctuations which were sometimes reported. Although bankruptcy abruptly terminated Joseph's downtown thermometry, the torch was passed to others in the Jewellery trade, notably a Mr. Ellis and a Mr. Potter who also traded on King Street East, on the shaded southern side.

Despite the extensive availability of thermometers in the city core, and their wide use in private homes, the resulting temperature record is meagre. You find it in private diaries and papers, such as those of Larratt Smith, and more importantly, in the city's newspapers. The Globe office was downtown, as most of the newspapers were, in those days. When the weather was unusually hot, or unusually cold, George Brown or his designated subordinate could find a King Street thermometer to consult, and use it to write a little story about the city's weather. To find these references we have to crawl through the historic newspaper record, a painfully slow process. The results are a fragmentary and not particularly consistent temperature record. It emphasizes daily maxima and minima of temperature in the more extreme weather conditions. Instead of the long runs of temperature data, plural, beloved of climatologists, we have long periods of nothing, punctuated by a singular datum or two. Much of the time, especially once telephones were available, the newspapers relied on the all-seeing oracle at the Observatory for their temperature data, and the downtown temperatures become less visible.

The problem is that there is no really clear trend in these observations (Figure HI downtown). We can use them to plot a regression line through the cloud of points. Statistically, at least, it has a trend, and one of my statistical tests even indicated it was significant. But it still looks like a cloud of points, without a clear pattern. For the moment, unless more data can somehow clarify it, we don't yet have a clear temperature picture of the early decades of the urban heat island in the downtown core. Can we illuminate this period with data from other sources?

**Thermal Texture**

During the heat-waves of the mid 1930s, two Toronto women found equal but opposite responses to the heat of the city. One woman, an apartment dweller, escaped her overheated quarters by taking her bedding into the adjoining cemetery, and sleeping among the graves. Another woman, a City Hall clerk, deliberately courted the hot noonday sun by frying eggs and bacon on the hot stonework of the municipal steps. Entering the newspaper record among the human-interest stories, these illustrate the

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effectiveness with which people were able to read the detailed thermal geography of their surroundings. They had no trouble noticing which places were hot or cool. They could (and did) congregate in certain department stores, theatres, and banks with air conditioning or high ceilings. They sought out the cooler spots in parks, on the waterfront or within their neighbourhood. Third-floor walk-ups were deserted, and people camped out in their basements, or verandahs. Toronto people then, as now, were familiar with the complex variations in the city's thermal landscape, and had no trouble deciphering them at local level.

Although a certain generation of climatologists spoke of urban heat islands, cities actually have a complex thermal texture. On a satellite image the city's heat pattern is a spongy archipelago of hot, warm, and cool spots. It does, admittedly, stand out against the cool rural background, although low-density suburban sprawl makes the boundaries blurred. The Chandlerian technique of constructing thermal 'contours' is about the best you can do with scattered ground stations, but it is vastly inferior to satellite imaging. The classic 'contour' technique produces a lower-resolution image of the city's thermal geography, but it still, hopefully, picks up on its important large-scale features.

In detail, of course, the thermal geography of historic Toronto should resemble a modern satellite image in texture. Even in the Victorian city one would expect thermal hot spots, warm zones and cool interruptions in the urban fabric. Middleton and Miller's transect bring this out fairly well for the 1935-36 period. Their instrumentation was good enough that we can recognize the uneven thermal texture of a real city. They ran through some of the city's most intensely built-up sections, and plunged into cool ravines, before re-emerging into the suburban warmth. In a couple of cases, most notably the 22 February, 1936 transect, they drove the route twice, once northbound, once southbound, the city cooling measurably around them as they drove. You can sense some of the dynamism of the changing thermal pattern, as some places kept their heat, while others lost it fast. The intimacy of this thermal texture is rather too complex for this preliminary investigation, but it is authentic, and we need to bear it in mind.

Middleton and Millar chose, for reasons never really explained, to follow Yonge Street northwards from the lake to the fringes of Willowdale, beyond the city limits, if not actually beyond the suburban ribbon development. It was a route which took them past the suburb of Bedford Park, where Middleton lived with his family, but it still took them along one of the city's busiest arteries. Then, as now, it was a busy road and transit corridor, one of the city's longest. For much of the route it was an intensely urban corridor, cutting through the heart of the downtown core, and extending through dreary miles of low-rise commercial buildings with apartments above. On either side, with some variation, were suburbs whose residents commuted on the Yonge line. The densest masses of suburb were always closer to Yonge. Even at Yonge & Bloor, in what was then the city's midtown section, the Yonge corridor was heavily urban in character, an asphalt canyon thickly built with dense low-rise structures. It was rather different from the park-like suburban setting of the Observatory on Devonshire Place. Not surprisingly, on all their transects, Middleton and Miller found Yonge & Bloor to be much warmer than the Observatory. A mere 980 metres separated the Observatory and the transects at this point,
but the thermal distance was always much greater. On 22 February, 1936 there was almost as much of a temperature contrast over this 980 metres, as there was over the whole of the urban area.

In contemplating the city's temperature patterns we have to accept that these kinds of small-scale and micro-scale differences occur alongside the broader patterns of the heat island.

**Water Temperatures**

The waters of Toronto harbour provide another expression of the city's long-term temperature trends, although we are rarely dealing with an actual temperature record. It is also an area where the evidence is liable to be distorted by many other factors. But we should look into the available evidence.

Even today, Toronto's harbour frequently ices up for the winter, and the Great Lakes navigation closes. There is an annual ritual of awarding a beaver hat to the captain of the first seagoing ship to enter the port. The dates of freeze-up and spring thaw vary from year to year, as does the extent and thickness of ice cover. Nevertheless, it is a seasonal pattern, and one for which fairly long-term records exist. Despite considerable annual variation, these show a gradual long-term reduction in the duration of the harbour ice cover (Figure ice duration).

In the 1830s and 1840s Toronto harbour remained icebound for an average of about 120-130 days each year. By the 1930s and 1940s this had fallen to an average of 100-110 days of ice cover. By the 1970s and 1980s it had fallen below 100 days.

The duration of harbour ice cover is not, however, a simple analogue of the urban heat island. Ice cover is affected by salinity, by the runoff of road salt and by discharges of chorine from water and sewage treatment. In 1912, when cities were just beginning to use chlorine to treat water and sewage, and had yet to apply road salt, the chloride level was around 7.2 ppm in Lake Ontario. By 1969 it had risen to around 28 ppm, and was expected to rise further. At some point, of course, this salinity will begin to affect winter ice cover.

More significant though for the ice in Toronto harbour were sewage discharges, which continued throughout the year, and fouled the bay with water warmed by urban use. When the sewers were few, the ice cover was thicker. Nineteenth and early Twentieth Century people with long memories remembered that until the 1840s you could skate for miles across the city's immediate waterfront. In classic winter weather, thick skatable ice came right up to the wharves, and 5-6 miles of good skating could be had along the harbour. In most winters in the Nineteenth Century you could walk out to the Island on the harbour ice, as long as you were careful. Teams of horses pulled sleds of building materials across the winter ice. Daring Victorians held ice-boat races on the harbour.

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30 Port of Toronto News Feb 1972 p. 2.
There were tragic falling-through-the-ice accidents in most winters, but a long-running winter tradition of recreational use of the Harbour ice.

From the 1850s though, as sewers began to multiply across the waterfront, the extent and thickness of the harbour ice began to wane across the wharves. Ice thickened a little way out, but the city gradually ceased to have an icebound waterfront. Before about 1910, most of the city's sewers ran north-south down the main streets, and discharged untreated direct to the bay. They brought all kinds of filth, but also water at warmer temperatures than the harbour generally. People readily noticed that around the mouths of the sewers the ice would be thin, treacherous or absent altogether. Judging by newspaper reports of ice-related drownings, the ice at these sewer mouths was particularly likely to claim victims.

Lake temperatures, like terrestrial ones, are seasonally variable. The water is cool or cold in winter, but gradually warms in summer, and the cycle repeats. The presence of the lake modifies the city's temperature significantly. In the early part of the summer the lake remains cool, helping to cool the city in the early phases of summer heat. At the end of the season, the lake retains summer warmth, sufficient to delay the onset of winter by perhaps a month. The coldest weather in Toronto often comes at the end of January, or the beginning of February. Climatologists say that a gradually diminishing the lake effect extends as far inland as the Oak Ridges Moraine.

Lake temperature records are a little scattered. We find some turning up in newspapers, mainly in connection with 1930s reports on summer bathing beaches. Toronto people used these relatively shallow water temperatures to decide if the time was right for a swim. A more useful set of deeper water temperatures was collected by the city engineer, in connection with the water supply.

Edwardian era engineer's reports provide us with the lake temperatures at the water intake crib, off the southern shores of the Island. Monthly means, minima and maxima are available, based presumably on daily and perhaps hourly figures. Another set of water temperatures were collected too, for the water coming out of the taps at City Hall. This may reflect the temperatures of the soil through which the water pipes ran, but it is more likely to reflect the temperatures in the filtration basins at the Island Waterworks, where the water was stored to settle out sediment.

When we compare the two water temperatures with the relevant air temperatures from the Observatory, we can see significant contrasts in seasonal and daily temperatures (Figure wDTR). In general it was the air temperatures at the Observatory which had the greatest daily contrasts, with fairly high temperature ranges all year. In winter, the lake, and city hall tapwater were cool, without much daily contrast. But in summer, the lake and the tapwater warmed, and developed strong ranges of temperature.

Toronto in this period had a curious geography of tap water. Different municipalities drew their supplies from different points. The water in Edwardian Swansea and The
Junction tended to taste bad if the wind was in the east, blowing sewage into the intake.\textsuperscript{32} The same thing happened in the Town of East Toronto\textsuperscript{33} and to some extent in the city.\textsuperscript{34} Easterly blows muddied the city's water supply, but the same thing could happen if wet weather brought landslides to Scarborough Bluffs.\textsuperscript{35} Spring ice breakup was another means of fouling water supplies, notably for Swansea and the Junction.\textsuperscript{36}

Tap water also varied in temperature, according to where you were. Toronto's tap water often seemed to be colder than that of the Edwardian Junction. This was something of a sore point over which the Mayor of the Junction was likely to be defensive.\textsuperscript{37} City tap water had the curiosity of a major temperature contrast around College Street. South of there (including the taps at City Hall) the supply came in direct from the lake, and roughly reflected its temperature. North of College, the water came via the Rosehill reservoir,\textsuperscript{38} a fairly shallow water body at the best of times. In summer though, when demand was heavy, Rosehill got even shallower. Its waters readily warmed in summer sun, and tended to run warm out of the taps north of College. In times of water famine, the northern half of the city had a distinct tendency to run dry first.\textsuperscript{39} Higher water temperatures may also help explain the tendency of the reservoir to have significantly higher bacterial counts than the intake water.\textsuperscript{40} In the days before chlorine was used in water treatment, the taps north of College had more chance of killing you than the ones south of that line.

Over time, the city's water consumption, and therefore its sewage production, increased. Gradually, too, the population north of College expanded, consuming more water and increasing its output of slightly warmer sewage. We might expect, therefore, that the temperature of the harbour would reflect these discharges.

\textit{Lake Effect}

Toronto's thermal geography is significantly affected by the presence of Lake Ontario. The lake helps to moderate the urban climate, and somewhat alters the seasonal cycle. Toronto's winters are coldest toward the end of January and beginning of February as a result. The lake remains cool into early summer. A heat wave in early summer can easily have air temperatures in the mid 30s Celsius, while the water in the lake is only 10-12 °C, a little too chilly for pleasurable bathing.

Of broader significance for the heat island are the lake breezes which often blow inland considerable distances, cooling the city. These were, and remain, important parts of the region's thermal geography. Climatologists estimate that the lake influence extends as far north as the Oak Ridges Moraine.

\begin{itemize}
\item \textsuperscript{32} \textit{Toronto Star} 14 Sep 1906 p. 6.
\item \textsuperscript{33} \textit{Toronto Telegram} 19 Apr 1910 p. 12.
\item \textsuperscript{34} \textit{Toronto Star} 17 Apr 1906 p. 8; \textit{Toronto Star} 25 Nov 1907 p. 5.
\item \textsuperscript{35} \textit{Toronto Telegram} 19 Apr 1910 p. 12.
\item \textsuperscript{36} \textit{Toronto Telegram} 2 Apr 1904 p. 26.
\item \textsuperscript{37} \textit{Toronto Star} 21 Aug 1906 p. 8.
\item \textsuperscript{38} \textit{Toronto Star} 12 Sep 1895 p. 3.
\item \textsuperscript{39} [Toronto] \textit{Globe} 3 Feb 1904 p. 12.
\item \textsuperscript{40} [Toronto] \textit{Globe} 8 Mar 1910 p. 14.
\end{itemize}
We can certainly see situations in which the lake breezes significantly reduced the effect of the heat island. On one hot day in June 1870, for example, the *Globe* noted that J G Joseph's standard thermometer was a degree or two cooler than the one at the Observatory.\footnote{[Toronto] *Globe* 20 Jun 1870 p. 1.} This was despite a heat island whose $\Delta T$ usually left the downtown core at least 1 °C warmer than the Observatory. Joseph's store, at Yonge & King, was very much closer to the lake and its cooling breezes, than the Observatory. Indeed, in those days Yonge & King was itself much closer to the lake, without the 500 metres of lake-fill placed there in the early Twentieth Century.

We see the effects of lake breezes in the temperature patterns of the July 1921 heat wave. The heat of the downtown core brought anguish within the city, but thanks to lake breezes, the northern suburbs were actually hotter still. A similar effect can be seen in at least one of the temperature transects published by Middleton and Millar. During the evening of 14 August, 1935 they noted the downtown core was comparatively cool, while temperatures rose inland, peaking somewhere north of Eglinton Avenue.

The lake effect was extremely widespread in the city's thermal geography, and features in Middleton and Millar's temperature transects and all of our heat island maps to some extent. In all cases the temperatures of the city fall drastically at the lake shore, and the lake influence extends at least some distance inland.

**The emergence of the city's thermal mass**

Buildings and surfaces are at the heart of the urban heat effect. The city functions as a thermal mass, gaining and storing solar heat. Changes in the urban landscape lead to changes in its temperature geography.

Prior to 1860, Toronto was largely a wood and stucco city. Most homes were made of wood frame, sometimes faced with brick, or more commonly roughcast stucco. The downtown core held the majority of the city's brick and stone structures, but they were not numerous.

In the late 1830s Anna Brownell Jameson derided Toronto as a town of staring red brick,\footnote{Cited in Taylor 1887 p. 53.} but she was probably exaggerating. Perhaps she spent too much time moping over the poetry of Bettina von Arnim. Apart from Jameson's own house, there wasn't much red brick to stare at. The city's major commercial streets in the 1840s, King and Queen, were largely wooden as contemporaries remembered.\footnote{Pearson 1914 p. 60; Thompson 1868 p. 39.} Across the city, fewer than 15% of the buildings were of brick or stone. The city's thermal mass was small and confined to its modest downtown core.

The building cycles of the 1850s brought significant change. There was considerable building activity, especially along the waterfront rail corridor. The arrival of the railway began to transform the urban economy, and the urban landscape. The brick core of the
city expanded, the city grew outwards, and enlarged. Rail-based, industrial facilities emerged. Despite the risk of urban fires (for which the 1849 conflagration was a nasty object lesson) the city made little effort to require fire resistant construction. Where the brick core expanded, it did so because of land economics, not fire-limits bylaws.

It is difficult to gauge the extent of brick construction in the 1850s. Building materials were not recorded in the city's property tax assessments, and the city is lacking in census coverage. But we get a clearer picture after 1857, when the main building cycles of the 1850s had been completed. Their legacy, as the photography of Armstrong, Beere & Hime shows, was about 50 hectares of intense brick and stone construction. The main brick core straddled Yonge Street and extended along King Street, east and west over perhaps a kilometre. Beyond this small brick core, except for a few brick structures, were several square kilometres of frame and roughcast. Wooden structures were fairly scattered in the suburbs, with some denser clusters.

King Street was the city's main business artery in 1860. The assessment rolls show urban buildings lined King for about 4.3 km, but most of them were wooden or roughcast. Brick and stone buildings were the dominant structures for just 1.3 km, from Simcoe Street in the west to George Street in the east. Brick was even less significant on Queen Street, the city's secondary east-west artery. In the built-up 4 km between Bathurst Street and the Don River, brick structures dominated only 1 km, between York and Jarvis streets.

The situation had changed very little by 1870. The brick and stone section of the downtown core was still rather small, extending east-west along King and Queen for a kilometre or so, as it had in 1860. Brick construction expanded modestly during the 1860s, but reached only about 64 hectares of 75% brick construction by 1870. As before, the brick downtown was surrounded by a belt of roughcast and frame suburbs with scattered handfuls of brick and stone structures. As in 1860 this was a low-rise landscape, with the grander buildings only 2-3 storeys in height and not particularly fireproof. The city's relatively modest size and limited brick core meant that the urban thermal mass was still small.

Things rapidly began to change in the 1870s though, stimulated by a short-lived building boom and new fire limit regulations which aimed to prohibit frame or stucco construction in the downtown core. Like the 1850s, it was a decade of significant building activity, but this time, perhaps stung by increased fire insurance, the city's leadership imposed the first system of fire limits. From the spring of 1873 brick and stone construction was mandated for all new buildings in the downtown core. Frame was outlawed everywhere else, and roughcast was the new minimum standard for suburban fireproofing. The fire limits were shortly extended, and the requirements for brick and stone intensified. Enforcement was improved and by 1880 brick construction had become a widespread requirement.

We must remember that fire limits bylaws only applied to new construction. The bylaws applied to new construction or additions, but existing structures were exempt. The

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44 Toronto City Council Minutes 1869 Appendix Bylaw 503 26 Nov 1869.
photography of Toronto's inner city makes clear that roughcast and frame construction lingered deep into the Twentieth Century in the more run-down neighbourhoods. John McAree could remember large tracts of roughcast construction in the Victorian city's east end. It seemed as if entire neighbourhoods were built in this way.\textsuperscript{45} There are still plenty of roughcast buildings standing today.

Although people sometimes resisted fire limits bylaws, and the expense of fire-resistant construction, fire limits were applauded by many property owners. Each time the fire limits were revised, there would be petitions from property owners anxious to be included. Those who owned imposing or valuable properties wanted protection from the fire risks of cheap construction.

Brick fire limits had a host of consequences. They gave an immediate boost to the city's brick-makers but they also led to a significant expansion of the city's brick core. From an estimated 65 hectares of 75\% brick in 1870, the brick core more than doubled to 142 HA by 1880. It would double again in the 1880s, reaching 362 HA in 1890, and reach 420 HA by 1900. Even in phases of relatively slow overall urban growth, the brick core expanded rapidly. The trend would continue in subsequent decades.

Building height also increased, aided somewhat by improvements in the public water supply. Major upgrades in pumping equipment and the installation of high-pressure water mains allowed downtown water pressures to increase. The 15-20 psi of the old system, which hardly permitted firefighting, became 60-90 psi by 1880. While lawn watering and plumbed bathrooms suddenly became possible in the suburbs, hydraulic hoists and elevators became possible in the downtown core, and firefighters could protect much taller buildings. By the 1890s the brick and stone section had expanded to cover much of the city, and building height was increasing in the core. "Skyscrapers" of 5 or 6 storeys were rising at King and Bay.\textsuperscript{46}

By 1880 brick had become the standard material for all new middle and upper class homes. Brick accounted for 80\% of the building permits issued for houses in the 1890s. The figure climbed even higher in the early Twentieth Century. Many of the permits issued for dwelling alteration were for the conversion of frame or roughcast homes to brick. By 1920 most of the city had been converted to a brick-dominated landscape, with roughcast and frame persisting in impoverished pockets. The slums of the Ward were still largely roughcast down to the 1930s, as were those of Corktown, South Riverdale and parts of the Junction. Frame and roughcast characterised much of the suburban fringe of worker's suburbs. They were abundant in the self-built shacktown suburbs of East York, Fairbank, and Silverthorn. With vast areas of the city devoted to brick, building material had become a symbol of social status.

Another aspect of the city's developing thermal mass was the overall height of its buildings. The 1840s city had generally peaked at 2-3 storeys in the downtown core, with nothing except church towers above this. By the 1880s 4-5 storey brick buildings were

\textsuperscript{46} [Toronto] \textit{Globe} 6 Sep 1894 p. 10.
characteristic of the core. The later 1890s saw the city's first skyscrapers and in the decades before the Depression the urban canyons grew deeper.

Events such as the great fire of April 1904 had only a temporary impact on the developing downtown thermal mass. The fire struck down some of the roofs and iron towers in the Wholesale District, but most were quickly replaced. Many of the old buildings would have been demolished anyway in the boom of the 1920s. Thanks to the fire, the new structures were required to have much thicker walls, increasing the density of the thermal mass still further.

In the early decades of the Twentieth Century Toronto's small but ambitious collection of skyscrapers gained lots of attention. They caught the eye, and frequently irritated the architectural critic, but their numbers were fairly small. The height limit bylaws were toothless and frequently ignored by aldermen anxious to accommodate the latest, flashy tower of commerce, but the rate of construction was slow. There were only three buildings above six storeys in 1908, sufficient to be impressive, but not enough to dwarf the 1898 City Hall or the spire of St James. During the 1910s and 1920s the tallest buildings reached 300 feet (91 metres), and began to dwarf the city's great Victorian monuments. By 1930 several Toronto buildings had claimed the title of the tallest in the British Empire. The Bank of Commerce and the Royal York Hotel were two of the best known. The 1906 Traders' Bank and Bank of Hamilton buildings, the CPR building, and the Royal Bank building had all preceded them. Lurid, lofty, and vast though they seemed, Toronto's skyscrapers could not offset the proliferation of mid-rise buildings in the urban core. This was probably more significant, in the long run, at enlarging the city's thermal mass.

Street Surfaces
Most of the streets of the Victorian city were rather crudely paved with loose and unsealed surfaces. The majority of the city's roads became muddy when it rained, and dusty when it was dry. The sidewalks were mostly wooden, requiring frequent replacement due to rot or breakage. In times of severe winter poverty sidewalks were sometimes stolen for firewood. On the plus side, wooden sidewalks gave a better footing for pedestrians in winter, while concrete ones became skating rinks.

The major deployment of concrete sidewalks and asphalt roads came only from the 1890s and later. There were just 5 miles of concrete sidewalk laid by 1890, a small proportion of the city's total. Nevertheless, in 1893 the city decided to phase out wooden sidewalks downtown. Replacement was slow, and by 1900 there were only 25 miles of concrete sidewalk in the city, versus 400 miles of wooden sidewalk. The Edwardian era saw the proportions reversed, and by 1910 there were 452 miles of concrete sidewalk laid in the

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50 Heaton, Ernest (1924) "Toronto, an encyclopaedia with maps and street car directory" p. 7.
city, and just 75 miles of wooden walks remaining. Asphalt road surfaces followed similar lines. There were just 10 miles of asphalt roads in the city in 1892, but it had increased to 30 miles by 1900, and 60 miles by 1906. By this stage, there was more asphalt mileage than any other paved road surface. Asphalt roads reached 120 miles by the beginning of 1910 and 200 miles by the end of 1913.

Asphalt surfaces were well-suited to the bicycle and to the motor vehicle, and had become standard for new urban roads by the 1910s. The new normality was a road of asphalt with brick gutters, concrete curbs and sidewalks. The city embarked on this new regime in the 1890s, and enlarged it in the Edwardian period. Because it was deployed first in the downtown core, we can expect it to accentuate the solar gain of the central city from the 1890s, gradually extending outwards as the new paving systems were more widely used in the Edwardian era.

There was a tendency, though, for it to be installed more rapidly in upscale suburbs, where asphalt reduced the dust and improved the ride for cyclists. The emerging demands of motoring made asphalt a more widespread necessity, deep into the surrounding counties. The expansion of asphalt in the Edwardian era was exceeded only by the aggressive pace of urban sprawl. Despite energetic paving activity in the 1910s and 1920s, suburban motor roads spread outwards faster than asphalt paving could keep up. For most of the 1920s the city merely oiled the loose-surface roads of North Toronto and could not asphalt them until the Depression. Deeper into the suburban belt, in the more impoverished suburbs of York Township, asphalt paving was a prestigious rarity in the 1920s, reserved only for more upscale subdivisions and major arterials.

After 1945 the creation of paved roads and highways expanded on an unprecedented scale. Provincial production of sand and gravel shot upwards, way ahead of population growth. The voracious demand for aggregate being met by an archipelago of quarries and pits thrust deep into the urban fringe. Most of the new roads were suburban, and within the city, space pressures kept additions to road mileage rather modest. However, the city did begin a programme to pave back lanes. These had been oiled in the 1930s to keep down dust, but from the 1940s became gradually paved in concrete and asphalt.

Looking a street surfaces overall, it would appear that their major contribution to the city's developing thermal mass should be in the Twentieth Century. However, they were in a position to boost the thermal mass of the downtown core from the mid 1890s. The era after 1900 saw increased use of asphalt and concrete, but more importantly the new system of paved motor roads greatly increased the sprawling nature of the city.

Shade Trees
One of the countervailing influences on urban heating was vegetation, particularly shade trees. How did they modify the emerging thermal mass?

Before 1860, as text accounts and street photographs make clear, Toronto was "builted in the leafless tracts". It had virtually no shade trees on the downtown streets, and they were deficient in the suburbs. Urban tree cover survived best on private land, either as
ornamental plantings or as remnants of the original forest cover. It was extensive only in the outer suburbs. The pines and hardwoods of Allan's bush and the pines of Molly Wood's bush were two of the best known early-Victorian examples, but otherwise there was very little tree cover on public property. In the public spaces downtown, there was no room and in the suburbs, no protection. Suburbanites complained of the depredations of boys, calves and goats. The only major formal plantings of shade trees had been undertaken on College Avenue (now University Avenue) in the 1840s, and in private grounds. The city had, however, developed a preference for planting the horse chestnut, in contrast to American cities with their maples and elms.

During the 1850s and 1860s, in response to phases of hot weather, and goaded by the examples of US cities, various Toronto voices were raised in favour of public shade trees, but with limited effect. The issue probably wasn't cost. Shade trees were cheap to buy (25 cents would get you a 10 foot horse chestnut in 1868, ready for planting) but difficult to establish in the packed dirt of a city road allowance. Wandering goats, pigs, horses and cows ate and damaged the bark of young trees. Once planted, the trees needed staking and protection, regular watering and pruning. There was no public policy on what to plant or even how best to protect what had been planted. By the mid 1870s an attempt had been made to place shade trees under city control, and to protect them for vandalism, but it was haphazard. The City Commissioner, who managed city properties and undertook street cleaning, was in charge. We have to wait until the 1890s before the city brought shade trees under a comprehensive programme, run by the Parks Department.

After 1865 the city gradually improved its arrangements to protect, tend and plant shade trees on the public streets. Horse chestnuts were a frequent and favoured planting on suburban streets and in suburban parks before 1880. They impressed a visiting Walt Whitman, and various other observers. The horse chestnut grew quickly and its summer blossoms sustained the idea that shade trees should also be ornamental. By the 1890s the tree-less downtown was surrounded by a collar of suburban streets with shaded by mature horse chestnuts. In places slippery elms, willows and birches supplemented the bizarre ecology of this urban forest.

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53 Pearson 1914 p. 57; Taylor 1887 p. 50.
54 Pearson 1914 p. 94.
55 Thompson 1868 p. 34; Taylor 1887 p. 53.
61 TCM 26 Oct 1868 #497; 19 Aug 1874 #800; 20 Sep 1875 #965.
62 TCM 1875 Appendix 163 Bylaw 694 passed 18 Oct 1875.
63 Walt Whitman’s Diary In Canada 1904 Jul 26-27 1880.
64 [Toronto] Globe 6 Apr 1883 p. 6; C. Blackett Robinson 1885 History of Toronto and the County of York Volume 1: 322.
65 Mulvany 1884 p. 44.
All of this was to have unfortunate consequences. By the 1890s the shade tree forest had the warped ecology of a horse chestnut oligarchy, if not quite a monoculture. It was sickly in many places, and was quickly devastated by the White-marked Tussock Moth. Spreading rapidly through the urban forest in the mid 1890s it rapidly infested most of the city's shade trees. Despite desperate spraying with Paris green, the application of medicated tree bands and bribing small boys to climb and collect cocoons, the city lost the battle against the moth. Infestations would recur at 5-6 year intervals until the 1950s. The situation was only salvaged by replanting the shade tree cover with maples and elms, which the beetles attacked, but less successfully.

Thanks to the vain attempts to control the Tussock Moth we get a clear picture of the city's shade tree coverage in the 1890s and early 1900s. It is evident that, after a poor start, the city had indeed developed significant suburban shade tree cover along the streets in the 1870s and 1880s. With few exceptions, the shade tree did not penetrate the old brick core of the city. In the area south of Queen, between Simcoe and Berkeley shade trees were very scanty indeed. The last of the chestnuts remaining on Bay Street, south of Queen were felled in the spring of 1882.

After the mid 1870s the shade tree cover faced significant pressure from traffic and development. Shade trees had to compete for airspace with overhead power lines, telephone and telegraph cables. Their root systems were disturbed by the laying of water lines and the installation of sewers. They were pruned to suit the needs of street lights. By the 1880s the city was pruning and topping thousands of trees every year, and it increased in scale in the 1890s. Down below the trees competed with vehicular and pedestrian traffic. While sidewalks were wooden, and the roads unsealed, tree roots were left to wander. Water penetrated easily into the urban ground and a mature tree could adapt. Trenching and reconstruction for asphalt paving and concrete sidewalks proved destructive to mature shade trees. The sealed road and sidewalk surfaces reduced the tree's summer water supply, while the digging and cutting disrupted their roots. The Parks Commissioner, responsible for maintaining shade trees noticed the destructive impact of concrete sidewalks and asphalt paving almost immediately. The new street surfaces greatly increased the losses of shade trees, especially on the busy streets.

Taken together, the city's shade tree cover never became well-established in the downtown core, and tended to retreat from its development pressures. Although it had some kind of a presence in the suburban collar, the shade tree was not in a position to counteract the heating effects of the downtown thermal mass.

The shade tree, a modest modifier of urban temperatures, therefore had to exert its main effect outside the downtown core. It also tended to retreat from development and traffic pressure, which would intensify along the main arteries in the early Twentieth Century. Fine shade tree systems, including those of Spadina Avenue, would be destroyed by the mid-Twentieth Century to make room for motor traffic. The bizarre ecology of a horse chestnut-dominated urban forest produced problems of disease and parasite attack which forced the tree cover to be radically changed to a maple-elm dominated mix. Even so, it was the better-quality suburban residential areas which benefited most. The shade tree
losses on Jarvis and Sherbourne Streets were quickly made good, but when the horse chestnuts of Chestnut St and Centre Avenue succumbed to the Tussock Moth, they were not replaced. The slum children of the Ward, as the Fresh Air Fund noted, were left to scrabble in the unshaded dust through the hot inner city summers.

Emerging Urban Heat Stress
We opened the chapter with a graphic description of heat stress during the hot July of 1921. Sweltering weather brought dramatic changes to the city's way of life, and inflicted considerable suffering on some of its inhabitants. This type of news coverage is quite widespread in North America, many of whose 'heat waves' have proven deadly. An estimated 500 people, for example, died in Chicago's 1995 "heat wave", with or without suitable media scrutiny.66 The July 1921 coverage, therefore, represents a type of journalistic literature, one widely-shared and sporadically used whenever temperatures seemed to warrant.

If we trace that type of journalism backwards in Toronto's history we find that it began in the 1860s, although on a modest scale. Indeed, it is because of that kind of journalism that we have a published temperature record for the downtown core from that time.

The realities of urban heat insinuated themselves into many parts of the written record. In the 1840s to the early 1860s there were numerous references to the attractiveness of country air, to the cool lake breezes, or the shade of a forest in summer. On the Queen's Birthday 1861, for example, the Globe considered that "every man or boy whose inamorata will foolishly trust herself with him" would wish to "drive a few miles out of town to breathe the pure country air". Although such outings might have other purposes, shade, lake breezes, and country air were all reasons for 1860s summer excursions.

As time went on, however, the rationalizations shifted in emphasis. The coolness of the lake, the purity of rural air, the superior air quality of the suburbs continued to be acknowledged, but they were accompanied increasingly with more stressful language. By 1870, we are told there was "a general desire to escape the dust and inconveniences of the city where the thermometer, for some days past has stood at wasting point". Dominion Day in 1878 was 88 °F in the shade "but this only increased the desire of the people to get away from the hot and dusty streets". The escape metaphor continued in an 1879 tourists' guide: "How to escape city heat and dust during the dog days" in which "the advent of the sultry weather of midsummer" persuades all who can to leave the towns and cities "to some rural spot". For those who had to stay in town Toronto people had "lots of opportunities for a few hours respite from heat and humidity". Victoria Park and Lorne Park offered "temporary respite from the heat and dust of the city".

Stressful language accompanied the development of the parks system in the 1870s. Queen's Park and the proposed Riverdale Park were not merely hailed as progressive ornaments for the suburbs, but as breathing spaces, where manhood could be invigorated. During the heat waves of the 1880s onwards the parks became refuges from the heat. A

temperature of 83 °F on July 17, 1881, for example "caused many to seek the lake breezes and cooler resorts of the Island and parks". On August 4, 1881 the city's parks were crowded with citizens driven there by the heat. On July 16, 1882 the sultry weather "... largely increased the number of visitors to the Island and all the suburban places of resort, wherever a breath of fresh air and the cooling shade of trees was obtainable. Hanlan's Point and the vicinity of the Island Park were well patronized and the cooling wind from the bay and lake rendered a shady seat particularly pleasant during the prevalence of such excessive heat".

Sweating summer days continued however, and the language used to describe the effects of heat grew ever more extravagant. Temperatures were in the mid to high 90s °F in the heat-waves of the mid 1890s, making office workers' "collars wobble like coercion candidates in an orange constituency". Aug 4, 1896 was a hot and humid day, with 80% humidity and 88 °F in the shade. The city was "suffering and sweltering, especially downtown". The heat seemed to be worst in the wholesale district. A woman in her 40s collapsed and died on the Esplanade. She was unaccountably wearing a black dress, black hat and black ostrich plumes. Several steers being driven on Front Street collapsed in the heat. Hot men downtown uttered profanities. The next day things were no better. "People grill in the street" said the Globe. "The City lies sweltering under a boiling sun". Sales were vast at ice-cream counters and in stores selling light weight clothing but "perspiring clerks with moist handkerchiefs stuffed between their limp starched collars and their clammy necks" toiled in the weekday heat. Anyone who could, escaped to the Island or the Bay. The heat-wave continued for a few more days while the "toil-worn masses of the city who chained to duty in ill-ventilated workshops and warehouses, were unable to escape from the heat". However the "festive soda-water men" were not complaining.

Another August heat-wave in 1899 drove women and children to ride the streetcars in an effort to escape the heat of the urban centre. They rode the beltline cars aimlessly. For a modest sum you could be whisked away to circuit the cool suburbs if you could endure the short beltline trip through the downtown core.

One of the hottest periods of the early Twentieth century was July 1911, when the heat drove thousands of Toronto residents to sleep in parks or the beaches. Mortality rose, absenteeism increased in the brickyards, foundries and workshops. Bricklayers stopped work and heat prostrations were reported from the gas works, city hall, the Empress Hotel and other localities. July 1912 was also hot, and marked by large numbers sleeping in parks. Some 30,000 people and 500 baby carriages went to the Island on the hottest day that summer, and most refused to return to the city at midnight.

There is a trend to these descriptions. While it is difficult to tell if the urban heat was getting worse over time, they document the growing desire to avoid the urban heat. The city was hot, while the lake, the countryside and the suburbs were markedly cooler. Did the intensity of the contrasts increase over time?

The descriptions before the mid 1860s speak of the pleasant nature of the lake breeze or the country air. Such air was fresh, clean, and invigorating. But from the mid 1870s we
see a more serious contrast. The atmosphere is described in tones which are increasingly oppressive. Parks, though pleasant, were breathing spaces, and eventually refuges from the heat, places where tens of thousands of people might sleep in the worst hot weather.

The implicit geography of these accounts is one of an urban heat island. The downtown core and inner suburbs became not only warmer in summer but uncomfortably warm and oppressive in a heat-wave. There is enough heat by the mid 1890s to kill people, horses and cattle in some parts of the inner city. We have in these vivid descriptions evidence for a worsening problem of urban atmospheric quality in the late Victorian city. The Edwardian city inherited a mature urban heat island phenomenon.

From the later 1860s it is fairly clear that the downtown core was the place of greatest documented heat stress in the city, if we can leave aside the hot work places for a moment. Most of the city's classic heat prostration stories, especially those whose victims were engaged in only light exertion, occurred downtown. The hot July of 1868, for example, saw two prostrations downtown on 12 July, a young man who collapsed on the sidewalk outside 230 Yonge Street, and a woman overcome by the heat outside 43 King Street West. During the warm July of 1878 there were several cases of "sunstroke" downtown, including an old lady who collapsed on King Street West and an expressman waiting with his team on Melinda Street. Another male pedestrian succumbed at Yonge and Grosvenor, while a cow collapsed as it was being driven along Front Street and had to be slaughtered.

The hot weather of the later 1870s and early 1880s felled horses at King & Bay, overcame visiting farmers on market day and brought bad language to the police court. Even in the shaded sanctuary of the suburbs the heat was sufficient to disrupt band concerts and theatrical productions. Gilbert & Sullivan lovers were dismayed by the wilting of Buttercup during a July 1879 performance of HMS Pinafore at the Horticultural Gardens. Captain Corcoran came to her rescue.

In the mid 1880s and early 1890s the newspapers reported generalized heat prostrations downtown, together with employees collapsing in hot workplaces. The heat of July 1892 was sufficient to disrupt the drill of the city's newly-formed 48th Highlanders, whose woolen kilts and highland bonnets proved unsuited to the urban climate. The reportage grew more dramatic in the mid-1890s, when stories of numerous heat prostrations were accompanied with more general disruption to the urban economy.

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72 Toronto World 7 Sep 1881 p. 4.
On 4 August 1896, for example, the *Star* reported that "people grill in the street" downtown as "the city lies sweltering under a broiling sun". In downtown offices "perspiring clerks with moist handkerchiefs stuffed between their limp, starchless collars and their clammy necks"77 sweated in the heat. The city was "suffering and sweltering, especially downtown". The heat was at its worst, the *Star* noted, in the Wholesale District, where a woman had collapsed on the Esplanade. Dressed in a black skirt, black waist, black hat and black ostrich feathers, she didn't stand a chance. Several steers being driven along Front Street also collapsed the same day, while in the adjoining business houses hot men uttered profanities. 78

Not only does this offer some pretty good examples of 'heat wave' journalism, it provides us with a graphic description of Toronto's heat island, centered on the Wholesale District, with the city's largest collection of massive multi-storey brick and masonry buildings. During this August hot spell the "heat attracting" downtown pavements were almost deserted. 79

*Killing Heat*

From the 1890s a new tone emerges in newspaper coverage of hot weather in the city. In place of the usual complaints about heat, we see expressions of anguish and suffering, even death. The magnitude of these impacts began to grow. Around 25 Toronto people died in the hot weather of early August 1900, including 9 children and 4 octogenarians. 80 In July 1911 the death toll reached 90, including 47 small children. A less-severe hot spell in 1921 killed 30. July 1936 was by far the worst, killing 500 in Ontario and 225 in Toronto. 81 There were enough heat-related deaths in 1936 to overwhelm the city's undertakers, who ran short of coffins, hearses, grave diggers and flowers. 82

Plotted in semi-log fashion against the values of $\Delta T$, we see an exponentially rising trend in Toronto's heat-related mortality. As the heat island strengthened, so the death toll became more severe.

The economic and social disruptions intensified also. The heat of August 1900 was severe enough in foundries, brickyards and other hot workplaces to force 1500 workers to be sent home. 83 An estimated 20,000 workers were idled by the heat in July 1911, and virtually all of the city's foundries closed. The increasing urban heat challenged the city's water supply system, and there were local water famines, as lawn watering drained the reservoir faster than the city could pump replacement water from the lake.

Using a combination of newspaper reports and death records we can reconstruct the geography of heat-related deaths. We will focus on the three most spectacular examples from the early Twentieth Century: July 1911, July 1921 and July 1936. Each was a little

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77 *Toronto Star* 5 Aug 1896 p. 1.
78 *Toronto Star* 4 Aug 1896 p. 1
different. These heat waves punctuated a period of rapidly-increasing urban sprawl and population growth. They varied in intensity, duration, and deadliness. But there were some remarkable consistencies. Most of the deaths remained concentrated in the city's lower elevations, where the city occupied the old bed of late-glacial Lake Iroquois. Even though urban growth in the 1910s and 1920s was spilling beyond this and had climbed the Davenport Hill, the deaths still concentrated at the lower elevations.

In contrast to some of the rhetoric of the city's health reformers and shill hyperbole of the Fresh Air Fund, the deaths showed no real tendency to cluster in the 'congested districts' and classic slums of the old inner city. Children were not, apparently, dropping like flies in the Ward. The deaths were remarkably scattered within the city's lower elevations. While poor elderly people died sweltering in rooming-house attics, the heat also killed middle-class apartment dwellers in Parkdale, and the occasional Rosedale matron. The major clusters in the pattern reflected not neighbourhoods, but institutions with a vulnerable population, infants in hot orphanages, and the elderly in hot nursing homes.

Over time there was a major shift in the age structure of heat deaths. In 1911 the emphasis was upon young children, and especially infants. They constituted 32% of the heat-related mortality in 1911, but only 18% of the dead in 1921 and a mere 3.7% in 1936. By contrast the proportion of elderly victims increased. In 1911 39% of the dead were over 60, in 1921 it was 44% and in 1936 they accounted for 72% of the casualties. These occurred against a background of shifts in the demographics of the general population, but not enough to really account for the contrasts in heat-related deaths. The birth rate of the 1930s, for example, was lower than in the 1920s, but not enough to really explain the dramatic drop in infant casualties.

**Responses to Urban Heat Stress**

We now have several themes we need to draw together. We have established that the city developed a heat island, although the dates of inception vary according to the data you consult. We can see how the thermal mass changed and intensified toward the city's core, while spreading outwards. We now need to look at how Toronto people responded to their emerging heat island, especially in summer.

**Cooling Systems**

The downtown cores of cities have numerous historians, and Toronto is no exception. We can thank Gunter Gad for a good deal of it. Scholarly interest has been directed to many things in the CBD. Researchers have looked at structural steel, elevators and subways in the creation of skyscrapers, for example. They have explored the social networking and communications infrastructure essential to a downtown core. In our case we need to devote some thought to the ventilation, cooling, and climate control systems of the historic city. It is a vernacular subject, and therefore somewhat overlooked by most existing scholarship.

The city's first cooling systems were fairly passive and simple in scope. In hot weather people moved cooking operations out of the main part of the house and into a summer kitchen, often physically moving the stove. People constructed verandahs and built
awnings, or planted trees to give shade. They opened windows, despite the street dust and flies. These were simple and long-running strategies, begun when Toronto was just a village with ambitions, and continued well into the Twentieth century.

Many of these strategies were space-consuming. Trees needed land, as did awnings and verandahs. Even summer kitchens needed a little extra space. In the congested parts of the city, especially as land values rose, these became expensive luxuries. The photography of the Victorian city, down to the 1950s shows us that awnings were unfurled everywhere that a business street caught the sun. On a hot summer's day you could walk on Yonge from Queen to King without leaving the shade of continuous awnings. Verandahs, once fairly common over the city's sidewalks, were suppressed as a fire risk and an annoying encroachment. They retreated to the private homes of the Victorian city, where they remain to this day. For a while the sawn off stumps of verandahs past tripped unwary pedestrians on the city's streets.

Awnings
Awnings were just as problematic, since they were often too low on business streets. Policemen lost their helmets and umbrella-carrying pedestrians collided with low-flying awning fixtures and frames. The hatters of Ottawa remembered George Brown of the Globe as a frequent customer. A tall man by Victorian standards, and a parliamentarian, he frequently damaged his top hats on low-slung awnings. In common with other tall Victorian men he ordered two of each hat he bought to offset the inevitable casualties.

Low awnings were added to the litany of nuisances of the Victorian city, and they were featured regularly in letters to the editor. They were the constant subject of aldermanic grumblings. The vigilance of the authorities was frequently requested, perhaps because the offenses were so common, but probably because the stove-pipe hat was such an important accoutrement of a bourgeois Victorian. By modern standards the complaints seem well justified. The awnings were rather low, with a despairing Works Committee suggesting in 1910 that 7 feet 3 inches be set as a required minimum height.

From 1910 we get systems of awning permits, which allow us to map the structures. The business streets of the 1920s city were extensively covered with awnings, but mainly on the sunny side of the east-west arteries. North-south streets had them on both sides, but less consistently. Some types of stores favoured the awning, with food stores being perhaps the most common.

The Ice Trade
Victorian Toronto's basic refrigeration needs were provided by the city's ice trade. By the end of the 1850s the city had a well-developed ice harvesting trade which collected naturally-formed ice from the numerous water bodies of the district, and stored it for summer use. The Lake, the Bay, the Don and Ashbridges Bay provided ice harvesting in volume, while the many inland ponds and springs served more discerning customers. The

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85 Toronto City Council Minutes 1910 Appendix A Works Committee Report #7 19 Apr 1910 p. 508.
arrival of the railway allowed the product to be exported to the hot cities of the United States, but much was shipped out by schooner when the navigation opened.

There was an interesting international trade in ice in those days. Regions with reliable frigid winters were able to harvest and ship ice to regions of heavy urban demand. New England was one of the major export regions for the European market, serving London for many years, until undercut by the lakes of southern Norway. New England also supplied ice to Calcutta and many tropical cities, thanks to its maritime connections and reliable frigid winters.

Toronto's ice harvesting also relied on the winter's cold, which normally allowed an excellent ice volume. In 1863, for example, Mr. Richards of Yorkville supplied 1,000 tons of local ice to meet the needs of the Federal Army of the Mississippi. It was shipped via Chicago by carpet-bagging contractors. The city harvested some 75,000 tons of ice in 1882, and had placed 100,000 tons in storage for the summer of 1883. Over the years, and certainly by the 1880s and 1890s, the scope of local ice harvesting was compromised by local water pollution. The ice in the Don, the Bay and even Ashbridges was tainted by sewage, while the sewers themselves warmed the bay waters and reduced ice formation. Lake Simcoe quickly became a more important ice harvesting centre.

Even with the demise of local ice harvesting, natural ice remained the staple of refrigeration in Toronto long into the Twentieth century. Ice-box refrigerators were on sale in the 1850s, along with refrigerated butter churns, ice cream makers and other devices for storing summer foods. Wooden ice boxes were staples of Eaton's kitchen appliances in the 1910s, with fly screens for added sanitation. During the 1920s the manufacturers of refrigerators turned out both electric and ice-box varieties. Wooden ice boxes required care to operate. Users of the McClary Model ice boxes, for example were encouraged to place the contraption in a kitchen, not a damp basement. The wood might swell and the box might not close properly. Condensation was to be removed from the interior metal surfaces once a week "to keep the air sweet" inside the device. Users were instructed to let foods cool before placing them inside the box, to reduce ice wastage. Most importantly, ice boxes required regular deliveries of fresh ice, usually once a week in hot weather. Stores added special ice doors. Householders haggled over the price and quantity and delivery men frequently had to supply half blocks.

Passive Ventilation
Ventilation was one of the great obsessions of Victorian sanitary science. It derived much of its conceptual power from the prevailing miasmatic theory of disease. Bad air and bad smells, it was thought, made people sick. Ventilation and the avoidance of the bad smells protected people from infection. The public authorities on both sides of the Atlantic deliberated energetically on the arrangements for ventilating emigrant ships, railway carriages, public buildings, schools and churches. Ventilating Anglican worshippers became an important priority for the reconstruction of Toronto's St James cathedral in the later 1840s.
In the 1850s there was a craze for ventilating stoves in Toronto, contraptions which promoted indoor air circulation. There were so many on the market that the *Globe* had to create a separate category for them in the classified advertising.

Ventilation was an architectural obsession too, and entered into the design of Canada's new parliament buildings in Ottawa. Cost overruns on Parliament's heating and ventilation systems in the 1860s scandalized the newspapers claiming to represent the Grit taxpayer. Ventilation was a major preoccupation of the Toronto School Board in the last quarter of the nineteenth century, and a feature of major renovations of Upper Canada College in 1877. The Smead-Dowd passive ventilation system adopted by the School Board in the 1890s was also implemented in the city's churches, including Cooke's in 1892. Ventilation, somewhat incongruously, was one of the selling points of Cook's Turkish Baths in 1887. Located at 176 King St W, it boasted "a perfect system of ventilation" heated by "a constant flow of purified hot air". It was, according to its advertising "the most perfectly ventilated baths in the world".86

The remarkable Dr. John Cassidy, a key figure in the medical campaign against smoke in late Nineteenth century Toronto, was a leading figure in the ventilation committee of the Provincial Board of Health. He addressed Toronto audiences regularly on the subject. As he did so, the city's better hotels did their best to present themselves as shady, airy and well ventilated. The Queen's Hotel, for example, the city's smartest in 1893, promoted its private shade trees and ready access to lake breezes.

Most of the ventilation systems in use in the city before the 1890s, however, relied on passive drafting systems, often assisted by heating convection. The major innovations of mechanical ventilation had to await the development of the electric fan, which was just entering the Toronto market in the early 1890s.

B F Sturtevant & Co, an American manufacturer was the best known supplier of industrial fan systems in the city, and provided most of installations made before 1910. In 1913 the company decided to come inside the tariff barrier by purchasing a Canadian subsidiary in Galt.

Sturtevant's fans and blowers, together with vertical ventilation shafts and high industrial ceilings were adopted by many of the large industrial and commercial buildings of the city in the 1890s and early 1900s. The Temple Building, for example, the city's first real skyscrapers, had Sturtevant fan ventilation by 1898, drawing its air supply from the roof, above the worst of the city's heat, dust and smoke. The 1898 City Hall on Queen Street also used Sturtevant fans. These were placed in the building's basement while the clock tower functioned as a vertical air intake shaft. The fans in the basement could supply 120,000 cubic feet/minute [56.6 cubic metres/second], enough to change the building's air supply in eight minutes. Filter screens in the basement provided dust filtration on the intake air. By 1905 a humidifier had been added to regulate the building's internal humidity in winter. The King Edward Hotel was the only other Toronto building to be so equipped. Despite its air intake system, City Hall had no means of cooling the air,

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86 TPL Baldwin Room Ephemera: 1887 Turkish.
although it could readily heat it in winter. Dust filtration was, in any case, fairly crude. By 1905 water-based "air washing" was being introduced, but the Bank of Nova Scotia was the only major downtown structure to use it.

Residential use of electric fans was well under way in the Edwardian period, and became really popular with the initiation of a municipal electrical system, the Hydro, in 1911. Integrated electric fans were a standard feature of most of the prestige apartments constructed in the 1920s, along with electric refrigeration, oil heat and private incinerators.

Air refrigeration systems were a great rarity in the Edwardian city, and tended to be found only in specialized buildings. Furriers had them, but understandably had few customers in summer. The City Dairy on Spadina Avenue had a wonderful refrigerated ice cream parlour, derived from their industrial refrigeration systems. There were also a few theatres which offered (or claimed to offer) refrigerated audience experiences. One of the earliest of these was the Royal Alexandra on King Street West, which by 1912 was claiming to always be at 65 °F [18 °C]. By 1920 it had several competitors. Allen Theatres by then had three suburban locations offering "ideal ventilation" in an ice-encrusted cartoonish font, with another two under construction. The Regent Theatre in June 1920 offered "kool klean komfort" to its patrons. The Windsor Theatre at College & Dufferin made similar claims, while the Hippodrome maintained a cool advertising image from the mid 1920s. It is difficult to tell if these were true air conditioning systems, but theatres, especially cheap ones, suffered a bad press. They faced snobbish criticism from the elite, clerical criticism from the pulpit and the wrath of parlour sanitarians who chided their allegedly inadequate ventilation.

Climate control was also a difficult issue in the retail environment, and was especially problematic for the large department stores downtown. Their massive buildings, so useful to their sales efforts in ordinary times, were sited close to the heart of the city's heat island. Their multiple floors, their constantly opening street doors, their acres of window glass, their crowds of shoppers created unique challenges for cooling and ventilation. Awnings and interior light wells certainly helped, but the retailers learned to shift their summer sales activity to the basement and lower floors. To avoid the hot afternoons, they adopted summer morning 'door crasher' sales promotions. By 1905 the Robert Simpson Company claimed to be devoting its basement and ground floor to the atmospheric comfort of women shoppers. In 1915 it used its basement to open a "Pure Food Hall" with powerful fan and air wash filtration systems. It boasted the city's most impressive collection of refrigerated display cases. Behind cabinetry of gleaming glass, enamel and nickel plate, amid frosty piping, white-coated salesmen flitted among the pork chops and scotch eggs to serve the customers.

A sense of atmospheric refuge runs through the history of Toronto's Victorian suburbs. The gentleman's suburban villa or the petit-bourgeois subdivision were marketed as places of atmospheric retreat, away from the city's noise, smells, smoke, dust, and heat. These were sections with ample provision of shade trees and greenery. The houses had
lawns, shrubbery and verandahs. They had plumbed bathrooms, awnings, and multiple fly-screened windows to provide ventilation. By 1900 the better suburbs had dustless asphalt roads and concrete sidewalks. Their residents could afford the new electric and gas appliances which reduced the requirement for a coal stove in summer, and many could afford household servants to handle the hot drudgery which remained. Suburban summer evenings were spent amid the sounds bicycles whirring on the asphalt streets, listening to the quiet conversations and laughter of the neighbours, and hearing the sounds of unseen pianos. Cigars glowed in the mouths of gentlemen in duck suits lounging in wicker furniture on darkened verandahs. Many homes had constructed outdoor sleeping porches.

The public park greatly boosted the sense of *rus in urbs* of the middle-class suburb. Prior to the 1870s, the city had very little public parkland. There were government preserves of open space on the Garrison Common, at Queen's Park and on the Island, but the city had few municipally-controlled public open spaces.

From the 1870s, this began to change, and the city made important moves to create a parks system. During this decade, Toronto secured the first major tracts of parkland in the suburbs. It secured Queen’s Park, acquired Riverdale Park, Bellwoods Park, the Exhibition, Allan Gardens and High Park. It was also a decade in which arrangements were made to acquire the Garrison Creek and Castle Frank Brook ravines with the ultimate goal of more parkland. Accompanying these moves were civic rationalizations that the city needed open spaces in which citizens could enjoy ‘fresh air’, and escape the urban heat.

The same mood accompanied newspaper coverage of the major public holidays in the 1870s, in which the urban citizen took to ferry boats, excursion steamers, excursion trains, suburban resorts, suburban parks, pleasure grounds and picnics to escape the urban heat. Newspaper discussions of the urban atmosphere in the 1870s were liable to mention fetid urban summer heat, the stifling confinement and dust of the city core and the smoke of factories, all of which contrasted to the pure cool air of the country, the suburbs and the lake.

While those with enough money gravitated toward their suburban atmospheric refuges, the residential districts of the inner city became associated with the other side of the class divide. Toronto's emerging "classic slums" of the Ward, Corktown and King-Niagara were all firmly inside the city's thermal core. Middle-class observers of these inner city districts were inclined to describe the atmospheric quality in negative terms, especially in summer. The ‘congested districts’ were smoky and dusty with the emissions of the factory and the street. They lacked ventilation and were hemmed in by taller buildings. They had few trees, and lacked shade. Their tiny yards and lanes offered no escape to fresh air, while the low-rent dwellings lacked fly screens. The sweltering heat of the slums, their smoky and dusty atmosphere quickly became a standard metaphor in middle-class perceptions. It was present in practically all of the descriptions of slum conditions in Fresh Air Fund advertising from 1902 until the 1940s.
Summer Population Shifts

Despite a fair amount of population movement, there were no large-scale season-long population losses in Toronto summers. Some people left the city during the warmer months, especially those who could afford it, but the bulk of the population seems to have remained resident. Most people couldn't afford to quit their homes and jobs. The city's transit system shifted its biggest passenger volumes in summer, especially at Exhibition time, but more generally throughout the summer. The sustained summer population was also the testimony of the city's public washrooms. This was not surprising since the network of public lavatories had been built in concert with the transit system. Like the streetcars, the public lavatories saw increased traffic in summer. You could argue that some of the facilities (such as those at Sunnyside) were in locations which might see summer excursion traffic, but even the downtown locations told the same story. One of the most central was in the heart of the downtown core, where Toronto Street and Adelaide Street East intersected. This subterranean temple of porcelain and brass served the city's men, but consistently saw more 'attendance' in summer than in winter.

Conventions and tourism also helped sustain summer populations in the city. Toronto was already a convention city by the 1880s, and developed a long-term relationship with visiting Americans. Tourist marketing in the 1910s, 1920s and 1930s presented Toronto as a pleasant lakeside summer retreat, and as a gateway to the vacation lands of Muskoka and the Kawarthas. City officials in the later 1920s estimated that summer visitors doubled the numbers of cars on the city streets. Even if Toronto people preferred to escape the city's heat in summer, it still could attract refugees from the heat islands of the American cities farther south. So the claims of the city losing a significant part of its population in summer may be exaggerated.

On the other hand, the city did see some strategic losses of its population in summer. Among the city's elite and social climbers there was a distinct social season, lasting from October to March, approximately. This was a period of receiving days, cotillions, receptions, soirées, balls and levées. The social scene became a regular feature of the newspapers from the later 1880s onwards, and was probably at its peak in the Edwardian period. Each spring, following a round of closing receptions, the elite decamped to the resort, cottage or summer home. There they remained until their massed return in the fall. The social season, after a fashion, moved with them. The exodus usually began in late April, and built modestly in May with perhaps 50 socialites departing each week. Once the schools dismissed in late June, the trickle became a flood with hundreds of socialites quitting the city.

Their annual departures left houses empty in Toronto. Some were rented out for the season to vacationing Americans, but most simply stood unoccupied. It was estimated in 1894 that more than 1,000 houses stood empty in the city during the summer, awaiting the return of vacationers. The city police, subservient to the interests of property, felt obliged to protect the homes of rich absenteees. Each empty property required two police visits a day, and with thousands away it became an onerous task. Most of the vacated properties stood in posh neighbourhoods, with asphalt streets. Noting this correlation, the
police decided to equip the city's first bicycle patrol, as a labour saving device. In 1894 the first four constables began to pedal through the July heat in their blue serge uniforms.

By 1902 the Toronto police were making 102,000 visits to vacant properties each summer, 38,000 visits a month at peak. For this enormous outlay of police time the wealthy householders were charged nothing, while the Chief Constable grumbled at the expense of accommodating the homeless in police cells.

Beyond the elite, it gets difficult to generalize how many left the city for the summer. The city's bakers noticed, or claimed to notice, a reduction in the consumption of bread after the end of June. This, they told the Toronto Star was a consequence of so many children leaving the city on holiday as "children are great eaters of bread".

Summer certainly brought population shifts within the city. Edwardian newspapers carried a great many advertisements for rental vacancies in May and June. As late as 1921 most of the summer homes of the Toronto elite were located in the city's suburbs, in places such as Balmy Beach, the Mimico Riviera and of course the Island. Most of the elite summer homes in the Toronto region were carefully sited to avoid the city's thermal core.

In addition to the seasonal shifts in population, were innumerable short-term movements. Toronto was a city which, since the 1870s, possessed the means for tens of thousands of its citizens to escape on day excursions. At weekends and on public holidays the temporary exodus could be significant. But there were mostly short-term relocations. Even so, they could extend deep into the city's social fabric.

Summer Excursions
Toronto people seem to have developed the habit of summer excursion travel in the 1860s and 1870s. The fleets of lake steamers and excursion trains increased, taking people in and out of the city. It became normal for every workplace, every church group, and every fraternity, to hold picnic excursions, by steamer, train or streetcar, in some suburban or exurban location. A great age of Sunday school-picnics had begun. The city contributed a number of suburban park developments, and the private sector added various private picnic and camping resorts. Victoria Park, Lorne Park and the Grimsby Campgrounds all got their start at this time. Cottaging began on the Toronto Island, at Balmy Beach, Mimico and in the Muskokas. Avoiding the city's summer heat had, apparently become a widespread activity.

Organized summer excursions have a fairly long history in Toronto, although it changes significantly over time. Early in the 1850s we find the firemen of the city organizing annual steamer outings to Niagara and other places. Amid much profession of unity and mutual solidarity, they were almost alone in their use of group excursions.

From the early 1860s we find the excursion has been taken up by a wider variety of groups. The firemen continued, but now the national societies were organizing annual steamer excursions. In the summer of 1862, for example, the English of the St George’s
Society took a steamer excursion on the Zimmerman to Queenston Heights in June, while in July the Scots of the St Andrews Society (and Highland Rifle Company) visited the same place by the same steamer. In August, quietly avoiding the nationalist connotations of the Brock monument, the Hibernian Society took the Zimmerman to Niagara Falls NY. The Orangemen organized another steamer excursion to St Catharines a few days later. The volunteer military units were also making excursions at this time; the Toronto Naval Brigade took a flotilla of small boats up the Don for a shady picnic and rifle match in August 1862, while 1,000 members of the volunteer force took steamer and train to Hamilton a week later for a day's manoeuvres and fine dining. In the summer of 1863 the military and national societies were joined in their excursions by the Oddfellows (to Cedar Groves, Lake Simcoe) and the Toronto Mechanic’s Institute (which held a modest picnic at Rosedale).

As the excursions became more common, we see the emergence of pleasure grounds designed to accommodate them. Sunnyside was one of the first, with a dancing pavilion and refreshment booth. It was in heavy use for the Queen’s Birthday in 1861 when a picnic was held for 500. Summer Hill and Rosedale Gardens were operational by 1862-3. Accessible via the new streetcar system, they offered refreshments, tents, dancing, concerts and a succession of female tightrope artists. At Summer Hill a constable was engaged to patrol the grounds and maintain decorum. No improper characters were admitted.

By the later 1870s the excursion habit had widened to the point where a summer excursion or picnic outing was a routine part of every Sunday School, labour union, trade association or sports club. The Socialists, for example, went to Victoria Park in 1882 for a picnic and rally. The excursionists listened to suitably fiery speeches as they digested the food packed by the female comrades.

The summer of 1882 provides a suitable example of the broad nature of excursion activity at this time. Victoria Park accommodated excursions for the Northern Congregational Church (13 July), Duchess St Presbyterian Mission and Cannington Presbyterians (both 17 July), Grace Anglican Church and the employees of the Toronto Grey & Bruce Railway (20 July). Lewis St Baptist Church and Leslieville Methodist showed up on 25 July, the Sons of Scotland appeared on 29 July, the St Aloysius Society on 31 July. The Orangemen of lodge #404 tactfully delayed their visit to the following day, 1 August. Erskine Church visited 3 August, followed on 31 August by the Robert the Bruce Camp #2 of the Sons of Scotland.

Victoria Park billed itself as a family resort, with suitably temperant attractions. By contrast its west-end rival, Lorne Park appealed more to the working man. It had a bar (Mr. Lennox’s hotel), a dancing pavilion and was served by a steamers each of which sold alcohol. In the summer of 1882 it was visited by the St George’s Society, two outings of Great Western Railway employees, the Dry Goods Dealers and 1,500 members of the Brotherhood of Locomotive Firemen. Most memorably, on Dominion Day 1882 (1 July) after a drunken disturbances on the inbound steamers, a riot broke out at Lorne Park, in which Lennox’s hotel was destroyed. The cause is unclear, but one of the
gymnasts objected to the playing of the string orchestra. The scandalous affray, quickly labeled the Lorne Park Riot, occurred in front of 3,000 spectators. There were further disturbances on the homebound steamers, two of which collided on entry to the Port of Toronto. All the more remarkably, these disgraces did not prevent church groups from bringing excursions to Lorne Park in the days following. Woodgreen Methodists visited the park on 20 July, while a succession of Baptist churches (Yorkville, Beverley St, Parliament St) and Knox Presbyterians sent their picnic parties during July and August.

By the 1880s it is clear that short suburban or exurban excursions had become a summer routine for a large part of Toronto's population. As we have noted, by the early 1880s 30-40% of the city's population took part in excursions to parks and resorts on summer public holidays. The pattern continued solidly through the 1890s.

Day excursions continued to allow the working classes to escape the city’s heat in various ways. The Toronto Railway Company in the 1890s noted that a hot afternoon usually brought heavy traffic on the westbound streetcar routes, as families headed towards the cool ravines and swimming holes of the Humber River. Summer Sundays brought large crowds of picnicking families to the city’s parks and amusement grounds. Hanlan’s Point was a particular favourite, and by 1898 was billing itself as Toronto’s premier resort for the working man. One July Sunday brought crowds of 28-30,000 people to Hanlan’s, via the ferries, together with at least 500 baby carriages. The visitors swam in the lake and lolled under the trees. When the park closed for the night, it proved difficult for company officials to persuade people to leave the cool of the island for the heat of the city. As observers noted in the poorer districts, during the hottest weather people took to the streets to sleep, and entire families camped out in city parks.

So we have two contrasting realities. An established elite practice of out-of-town summer vacations, and more widespread tradition of short-term excursions and day trips.

Public Holidays
You can sense some of the changes in the public attitudes towards urban heat if you look at how the city celebrated major public holidays. In the 1850s Toronto was a magnet for out-of-town visitors on a spring or summer public holiday. On the Queen’s Birthday (24 May), the Orangeman’s Twelfth (12 July) there would be a major influx of visitors. They would join with substantial numbers of city residents to participate in parades, reviews, fireworks and other urban attractions. There were certainly some outbound excursions: a steamer or two pulled out for Niagara and some people left on the train for Hamilton or Lake Simcoe, but more came into the city than left. The outbound excursion traffic varied by year, but only accounted for 5-10% of the city’s population: the vast majority remained behind. Despite picnics and other excursions, the urban crowd was a major feature of public holiday newspaper coverage in the 1850s and early 1860s.

By the early 1880s the situation had changed dramatically. Most noticeable was a major increase in outbound excursion traffic on a public holiday. Ten or more steamers were at work, some running a shuttle service across the bay or along the shore, others crossing
the lake to more distant points. Substantial numbers also departed in various directions by rail, by streetcar and by road.

The crowds were now to be found on city streets in only two brief periods: heading towards the steamers and trains in the morning, and returning in the evening. For most of the day, the streets of the city’s inner core were deserted. In contrast to the 5-10% who went on excursions in the 1850s, by the early 1880s the figure was in the range of 30-40%. Instead of congregating on the streets of the inner core, people now went to the newly-created public parks of the suburbs, to the newly-opened private pleasure grounds outside the city, to the race track, or on rail or steamer excursions. Inbound visitors were not absent, but their numbers were dwarfed by the scale of the outbound traffic.

Somehow, between the later 1850s and the early 1880s, the geography of summer recreation in Toronto had been transformed from one in which the city’s streets and public spaces attracted the crowd to the city’s core, to one in which the crowd avoided the core. If they thronged at all, they did so in suburban and exurban parks and pleasure grounds.

Some of this reflects changes in infrastructure. In the 1870s there was a significant increase in railway construction, opening up a wider range of places which people could reach on the excursion train. The numbers of excursion steamers rapidly increased. Federal regulation, which tended to reduce passenger capacity for safety reasons, could not offset the huge growth in the passenger capacity of the excursion steamer fleet.

New infrastructure had also appeared in the form of pleasure resorts. There were new “temperance” resorts such as Grimsby Campgrounds, with its camp-meeting atmosphere, “family” resorts such as Victoria Park, and places of more popular attraction such as Lorne Park, Long Branch, Oaklands and Hanlan’s Point. In the 1870s the city made major additions to its suburban parkland, acquiring Queen’s Park in 1875, High Park in 1878, Riverdale Park (opened in 1880). Arrangements were in play for the creation of parkland along the ravines of Garrison Creek and Castle Frank Brook.

It is certainly true that the recreation patterns of the 1880s used these new facilities, but their creation also speaks to changes in demand. Although people in the 1850s had mostly been content to spend holiday time in the city, for some reason by the mid 1870s Toronto people were expressing a preference to get out of town on a public holiday. The numbers doing so eventually became massive. By the mid to late 1890s 30,000-45,000 people were crossing the bay to the Island and Hanlan’s Point. Some 12,000 made it to watch the Queen’s Plate at Woodbine.

The trend isn’t exactly linear, but over time, arguably some time before 1880, the attitudes of Toronto people turn against spending recreational time in the urban core in summer. The only major exception to this was 12 July, the day of the Orangemen’s parades. These increasingly grand occasions attracted visitors and spectators in the thousands and always featured a major parade through urban space. Although numbers might require uncongested suburban assembly and dispersal points, the aim was to parade
through the city’s principal business streets. The Orange parades were exercises in protestant testosterone, in which men and boys marched through the commercial and political core of the city. Accompanied by fife and drum bands, carrying banners, and wearing orange sashes over their black jackets, they laid symbolic claim to the urban space. In their own understanding they were asserting protestant ascendancy over the city’s principal business streets and public buildings. For psychological and political reasons the Orangemen wished to take symbolic possession of the city, and for this reason they had to parade through the urban core with its richly symbolic spaces.

Yet even in the Orange parades one detects a gradual disinclination to brave the mid-July heat of the urban core. The parades did not diminish in size, they were normally 2 miles long in the 1880s and 1890s, but the emphasis shifted somewhat toward the periods of formation and dispersal, both of which were distinctly suburban. In most years Queen’s Park was the starting point of the Orange parades, and the Exhibition Grounds became its customary ending point. The formation phase could last for several hours, starting in the early morning during which the bands played and the marchers stood in the suburban shade. The dispersal phase at the Exhibition became an elaborate gathering time, a period for orations and speeches, for sermons, protestant prayers and hymns, for music, lemonade and manly sports. Over time too, the marchers’ route spent less and less time in the inner city. Until the early 1860s the marchers regularly marched through the city from side to side, and quite deliberately paraded through the catholic districts of Corktown. By the mid 1870s it was customary to enter the downtown from the west, and leave immediately for the Exhibition. In the 1850s the Orangemen had held lengthy church services in the outdoors around downtown protestant churches, but by the 1870s they were no longer doing this. From the 1870s the marchers aimed to pass through the downtown fairly quickly.

By the end of the century, the 3,000 or so who might march in the Orangemen's parade in Toronto would be dwarfed by the 5,000 or so Toronto Orangemen who would march in Owen Sound or other centres. The Glorious Twelfth had become a time for Toronto Orangemen to take an excursion train and get out of town.

**School Vacations**

In the 1860s the city's schools allowed their students and staff a summer vacation of just 4 weeks. The schools went on vacation in mid-July and resumed in mid-August. The actual length of the vacation varied from year to year and sometimes proved too short. On one occasion there was insufficient time for the Board to complete construction work on the schools, and the children were given an extra week of holidays.

By the early 1870s the length of the summer vacation had crept up to around 50 days, and was approaching 60 days by the later 1870s. It now extended from early July to late August. From the later 1880s it was generally about 70 days in duration, from late June until early September. Even then, the schools were seldom full until after the Exhibition.
It is certainly possible that the increased length of the school summer vacation may be linked to the city's developing heat island. But this justification was not offered by the School Board.

Among the more elite schools, though, the educational challenges of heat did gain attention. The Principal of Upper Canada College, for example, argued that school examinations should be held in June. This would avoid the heat of July, something he felt was an unfair challenge to youthful scholars. Among the city's public schools there were some adjustments too. One primary school which served the posh northern suburbs of the city (Yorkville, Rosedale) had, by 1914 opted to hold its annual closing exercises in May as "so many belonged to the class which leaves the city on the first of June".

**Summer retail early closing**

If you wanted to know what effect summer heat had on Toronto people, all you had to do was to ask a shopkeeper. Victorian butchers noted that people preferred not to eat meat in warm weather. It was too hot to cook and, people said, it was difficult to digest. Those who sold clothing, furnishings and sporting goods noticed that summer demands differed from the colder weather. People wanted straw hats, skeleton suits, duck pants, light-weight cotton underclothes, white shoes and gloves. But beyond the seasonal goods, demand for clothing and consumer durables was soft in summer. Some retailers argued that people were waiting for the arrival of the "fall goods" at the end of August. By the mid 1870s it was customary for the retail trade to slow down between mid July and early September. Merchants reduced their advertising activity, and newspapers consequently grew a little smaller.

Retailers began to notice the summer slump in the 1860s, especially those who catered to the more carriage trade customers. Their employees had long complained about the extended opening hours typical of the trade, but from the early 1870s employee demands for summer early closing began to bear fruit. From the early 1870s the upscale dry-goods retailers and hardware merchants agreed to close early on summer weekday evenings, and on Saturday afternoons. It was hailed as a milestone in humane employment practices, but as the merchants well knew, the lack of upscale customers meant that it wasn't feasible to stay open. Piano and music stores joined the movement in 1873, jewelers, booksellers and stationers had joined by 1878. The movement spread to construction workers, with bricklayers and painters demanding Saturday half-days by 1873. Office clerks and factory workers began to secure similar concessions by 1880. By the summer of 1879, we are told, it had become general in Toronto business houses to work only a half-day on Saturday.

There were some difficulties with the early closing movement, of course. As in any collective action problem, there is always a difficulty in getting compliance. Some merchant, somewhere, is tempted to stay open in defiance. The merchants of King St E were the main instigators of the early closing movement in the 1870s, and they had serious difficulty with the upstart retailers of Yonge Street, who defied the early closing movement ion the hope of a quick dollar.
During the 1870s and 1880s the summer early closing movement was largely voluntary, and depended on agreement among the retailers in a certain sector. Jewellers, for example, decided to close at 6 pm on weeknights and after lunch on Saturdays in 1891. The hardware trades, the dry goods stores, wholesale grocers and department stores hatched similar schemes.

Another solution was an early closing bylaw, in which retailers would be compelled to close early on weeknights and Saturdays. After some vicissitudes, the necessary legislation and bylaws were enacted in 1890.

But the early closing bylaw raised other issues, especially those of the class-based nature of Toronto retailing. While the upscale customers seeking pianos, duck pants and glassware tended to disappear from the downtown in the summer, the working class customers were much in evidence. The factories were active, the construction and dock trades were in full operation, and as the retailers in working class suburbs noted, there was tremendous retail demand on Saturday evenings, as the women shopped on their husbands' weekly pay packet. The merchants of Queen Street East, but also those in Parkdale found themselves in conflict with the downtown early closers in the 1880s and 1890s.

Nevertheless, by 1890 summer early closing had become customary among the major retailers and business houses of the downtown. The sidewalks emptied of pedestrians, and the streetcars rattled through empty downtown streets on warm summer evenings. The wholesale district became so deserted in the evenings that special police patrols were instituted to deter burglary.

In most cases summer early closing was represented as a humane concession to the staff. It gave them shorter hours, and more time to recreate or be with their families. Some argued that it kept the employees sharper and made them more effective in sales. The demands for early closing came with the blessings of the city's more fashionable clergymen, of its more progressive social institutions and newspapers. In the general absence of middle and upper class customers, merchants found it easy to accede to the popular demands.

While the upscale merchants restricted their summer retailing hours, they continued to compete for the remaining customers. Sales and promotional activity continued in the city's newspapers, but sales events were frequently arranged for the early morning, when it still might be cool enough to shop. Timothy Eaton, rapidly followed by arch-rival Robert Simpson had the bright idea of instituting really good women's washrooms for the discriminating customer. In addition to the obvious hygiene functions, these offered the 'ladies' a chance to wash away the soot and dust of the city before shopping. Eaton's and Simpson's moved their discounted sales activities into the basement, where it tended to be cooler in summer, placed women's wear on the ground floor, and put other items in upper floors. Over time the grand department stores became the first retail spaces to experiment with artificial climate control, although the initial technology was very primitive.
Simpson's tried to create a cool ground floor for 'ladies' by 1900 to minimise discomfort for the female shopper. The company added a food hall in 1915 with a plenum-style system of air cleaning, dust filtering and fan ventilation. By the end of the 1920s Simpson's had adopted air conditioning, dust filtration and other devices to beat the torrid heat. Eaton's followed suit and by the 1940s was offering '5 air-conditioned floors' of shopping.

**Discussion and conclusion**

Although seldom explored by urban historians, or for that matter by climatologists, Toronto appears to have developed an urban heat island from the middle of the Nineteenth Century. It gradually strengthened and spread as the city grew outwards and its thermal mass expanded. Some decisions, such as the imposition of brick fire limits, probably accelerated the development of the heat effect, while others (such as the expansion of transit and rail corridors) served to spread the heat island to new areas.

It has taken a long time for scholarship to notice Toronto's heat island, but its people appear to have sensed its presence from quite an early date. We see myriads of interlocking patterns of adjustment and response, affecting policing, mail delivery, retailing, education and many other fields.

The emergence of urban heat islands played a role in changes over a vast geographical scale. We should assume that American cities, like those in Ontario, were experiencing heat islands. Ontario's vacation resorts, and to some extent Toronto itself, attracted American thermal refugees. The enduring imagery of Ontario as a vacation playground, its suburbs, its parks and recreational open spaces are all, to some extent, a legacy of urban heat islands.

As Toronto's summers grow steadily hotter, researchers tell us that the heat island has reached a $\Delta T$ of 5 °C and is easily visible on satellite imagery. Keeping cool in the urban summer has become a major drain on the electricity grid, and a major consumer of urban energy. Getting out of town for summer vacations, still a popular pastime, greatly increases the consumption of gasoline. Neither is conducive to improved urban air quality. How we face the challenges of continued urban heat is a matter of contemporary and future concern. But we should remember that urban heat islands are likely to have long histories, richly documented in recoverable sources. They are likely to have complex geographies and profound effects on the history of urban experience.
Figure DTR Jul. The monthly means of temperature in July at the Toronto Observatory. The dynamic temperature range (the difference between T-min and T-max reduces significantly after 1920.
Figure DD jul
Figure DTR jan
Figure DD Jan
Figure 1908. Toronto's heat island 4 Feb 1908
Figure 1910 W  Toronto's heat island 4 Jan 1910.
Figure 1910 J  Toronto's heat island 11 Jul 1910
Figure 1921. Toronto's heat island 6 Jul 1921.
Figure 1925

Toronto's Heat Island
Daytime Highs
5 June, 1925
Figure 1936  Toronto heat island 8 Jul 1936, daytime highs.
Figure 1955. Toronto's heat island 3 Feb 1955 from overnight lows.
Figure HI Area
Figure HI Downtown
Figure ice duration. A graph of the changing number of days each year that significant ice cover lasted in Toronto Harbour. The data comes from various sources, including surviving annual reports of Toronto Harbour, the harbourmaster's annual report and the newspapers. Many of the earlier years are to be found in [Toronto] Globe 25 Jun 1902 p. 5.
Figure wDTR. Dynamic temperature range data for Toronto's Island water intake crib and the tapwater at city hall. These come from the City Engineer's annual reports, plus DTR data from the Observatory, from Environment Canada data.
Figure Thermal mass
Figure shade tree cover
Figure Heat Deaths. The city's death registers were used to map those whose deaths were directly attributed to heat in the hot weather of 1911, 1925 and 1936. The changing extent of the built-up area is shown. In all cases the majority of the deaths occurred on the city's lower portion, below the Lake Iroquois shoreline.
Figure HID Delta T. Toronto's heatwave deaths plotted against the strength of the heat island.
Figure school vacations. From the early 1860s Toronto's schools gradually increased the length of the summer vacation. Data derived from newspaper reports.
Figure empty homes. From the 1890s to the 1920s there was a rapid increase in the number of Toronto well-to-do homes left empty and under police supervision during the summer vacation.
**Figure elite cottages 1921.** The summer homes of Toronto's social elite in 1921. The main map shows the number of summer homes across southern Ontario. Lake Simcoe, Georgian Bay and the Muskokas stand out. A number had summer homes within the Toronto suburbs, but as the inset map shows, these were outside the main footprint of the 1925 heat island. Data derived from the *Torontoian Society Blue Book* for 1921.