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NATIONAL RESEARCH COUNCIL

TORONTO FIRE OF 1904

BY

G. W. SHORTER

FIRE STUDY NO. 13



OTTAWA MARCH 1964

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CANADA

NATIONAL RESEARCH COUNCIL

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DIVISION OF BUILDING RESEARCH

ANALYZED

TORONTO FIRE OF 1904

by

G. W. Shorter

Fire Study No. 13

of the

Division of Building Research

OTTAWA

March 1964

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PREFACE

The great Toronto fire of 1904 not only shocked the nation but struck a serious blow to the Canadian fire insurance industry. This fire occurred in the heart of Toronto's mercantile district, the pride of the city, with more wealth concentrated in a few blocks than in any other area in the city. The buildings in this area were a most imposing sight with their massive masonry exterior walls. On 19 April 1904, a fire destroyed 100 of these impressive buildings within a period of nine hours.

The Division, believing that there is much to be learned from the large fires of the past, has encouraged such studies. This paper discusses the development of the Toronto fire and the resulting damage. It also compares various features of the Toronto fire with the Ottawa-Hull fire of 1900. This is the second in a series of papers describing historical Canadian fires being undertaken by the author.

The author, a mechanical engineer, is Head of the Fire Research Section, Division of Building Research.

Ottawa March 1964

N.B. Hutcheon Assistant Director



(photograph courtesy N. F. P. A.)

DESTRUCTION COMPLETE FROM LORNE ST. TO NEAR YONGE ST.

VIEW (FOLLOWING FIRE) LOOKING EAST ALONG FRONT ST.

by

G. W. Shorter

The weather in Toronto on the evening of 19 April 1904, was cold and blustery. The air temperature was below freezing (24°F) and snowflurries were occurring accompanied by strong winds from the northwest at 30 mph. All was quiet in the heart of Toronto's mercantile area. Few people were on the streets as almost all of the buildings in this area had been closed since 6 p.m. At 8.04 p.m., a police constable patrolling his beat in the area saw flames shooting skyward from the elevator shaft of the Currie Building, 58 Wellington St. (Figure 1) and immediately turned in an alarm. Before the resulting conflagration was extinguished, it would destroy approximately 100 buildings, causing a property loss of \$10,350,000.

Fire Chief John Thompson, one of the first to arrive at the scene of the fire, immediately turned in a general alarm. Having quickly decided that it was impossible to save the building occupied by E. and S. Currie Ltd. (neckware manufacturers), he concentrated the efforts of his department on confining the fire to this structure. A strong northwest wind drove flames from the burning Currie Building towards the rows of unprotected windows of the 6-storey building occupied by Ansley and Co. (wholesale hats and caps) and the Gillespie Fur Co. (wholesale furriers). This building was located at 56 Wellington St. immediately to the east and was separated from the Currie Building by a narrow lane (12 ft) (Figure 1). In an effort to stop the spread of the fire across the lane, Chief Thompson and some of his men took a hose line to the upper floors of the Gillespie-Ansley Building. In spite of their efforts, fire spread into the lower floors of this building, thus cutting off their escape routes through the building. They were therefore forced to use their hose line to slide to the ground. Unfortunately, Chief Thompson suffered a broken leg in the course of his escape and had to be taken to hospital.

A number of reports of this fire suggest that the confusion resulting from the accident to the Chief and the consequent delay in effective fire fighting at the outset of the fire were factors in the fire getting out of control. Following Chief Thompson's accident, Deputy Chief J. C. Noble became the senior officer in charge.

DEVELOPMENT OF THE CONFLAGRATION

With both the Currie and the Gillespie-Ansley buildings now burning the fire began to spread rapidly to other buildings in the immediate area. The times at which the various groups of buildings began to burn are shown in Figure 2. Fanned by the high wind the fire spread from building to building with such rapidity that within an hour at least 12 separate structures were ablaze with street widths offering no bar to the fire's progress.

At this time assistance was requested from neighbouring municipalities. Toronto Junction, East Toronto, Hamilton, Brantford, London, Niagara Falls, N. Y., and Buffalo, N. Y. all responded. Although most of the departments arrived 4 hours or more after the start of the fire, they performed yeoman service in the final stages of the fire before it was controlled and stopped. The first three departments mentioned arrived in time to assist in stopping the spread of the fire.

The development of the fire may be studied by using the plan shown in Figure 2. The fire crossed Wellington St. which is 66 ft wide, and swept in a very short time from end to end of the warehouse and book bindery of Brown Bros. and Co., 55 Wellington St. and the lithographing establishment of Rolph Smith and Co., 49 Wellington St. (Figure 3). It then spread south across Piper St. and the courtyard (which is about 40 ft in width) to the warehouses on the north side of Front St. The fire was prevented from spreading further in an easterly direction on the south side of Wellington St. by the action of the sprinkler systems installed in the Brock Building at the southwest corner of

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Wellington and Bay St. W. H. Brock and Co., 68 Bay St., wholesale dry goods, had installed in their building a sprinkler system which was supplied from two sources of water supply: gravity tank and city water connection. There were also outside sprinklers from the alley windows at the rear supplied by city water. This building did not burn until long after the surrounding buildings had burned down, the water curtain from the outside sprinklers preventing the fire from entering the building as long as the water pressure was sufficient to supply all the heads. The drain on the city water by the steamers and many hose streams, however, weakened the pressure until there was no water on the upper floors. It is thought that the fire then entered the building through the upper windows at the rear and that the automatic inside sprinklers opened. Since these were supplied by a gravity tank as well as by city water, they held the fire in check until the tank was drained when, there being no more water for the upper floor sprinklers, the fire soon gained headway throughout the structure and the building was completely destroyed.

All the buildings on the north side of Front St. west of Bay St. up to and including the premises of Warwick Bros. and Rutter, 70 Front St. (wholesale stationers) were quickly involved and ultimately destroyed. Between the latter establishment and the Queen's Hotel (now the approximate site of the Royal York Hotel) there was an open space of 60 ft. The hotel was only slightly damaged. After securing a firm hold on these buildings, the fire crossed Front St. and rapidly involved the entire block between Front St. and the Esplanade west to Lorne St. The only buildings that escaped were the brick office building located on the southeast corner of Lorne and Front St., several small structures fronting on Lorne St. and the Esplanade owned by the Hendrie Forwarding Co. The fire then travelled east crossing Bay St. below Front St. At about the same time the Barber and Ellis envelope factory and stationery warehouse, 43 Bay St. two doors north of Front St. became ignited. The fire then spread north, south, and east until all the buildings on both sides of Bay St. between Wellington St. and the Esplanade were burning, the fire having turned up Bay St. in the reverse direction from which it started.

In its earlier stages, the fire had spread up the west side of Bay St. as far as the Toronto Engraving Co., 92 Bay St. (Figure 4). On the east side of Bay St. the fire had been held at the Evening Telegram Building, 81 Bay St. at the corner of Melinda St. This building was also equipped with a sprinkler system but, although the front of the building was badly damaged, the fire was successfully fought with inside hand hose and no sprinkler heads opened. Good work was done at this building with a length of hand hose attached to a roof hydrant.

When the warehouses on Wellington St. east of Bay St. were reached, the wind was unfavourable to its further progress and the firemen were able to make a stand, preventing the conflagration from crossing Wellington St., but not without considerable damage to the buildings on the north side of that street. The fire was finally controlled at the envelope factory of Kilgour Bros. on the south side of Wellington St. The sprinkler system and water curtains installed at the Kilgour Bros. Bag and Box Factory, 21 Wellington St., played a most important role in the fire's control. Water for the inside automatic heads was provided by two gravity tanks (Figure 5) and by city water connections, while the outside heads were supplied by city water and an auxiliary steamer connection. In this instance the sprinkler systems functioned in much the same manner as those at the Brock Building. The exterior sprinklers continued to function effectively until the pressure was reduced (the steamer connection was not used) to a point where water was not supplied to the heads at the upper windows. The result was that the roof of that portion of the building fronting on Wellington St. and extending 200 ft to the south was completely burned with serious damage to every window. The inside sprinklers fed by the two large gravity tanks, however, continued to operate after the mains' pressure failed. The operation of this sprinkler

installation together with a system of good division walls prevented the fire from involving the whole structure.

A good example of sprinklers supplementing a standard fire door was provided during the fire in the Kilgour Bros. factory. An automatic standard sliding fire door was prevented from closing by some obstruction, so that a space about 6 in. wide was left open; six sprinkler heads opened on the other side of the door from the fire and prevented the fire from spreading to the adjacent compartment. The only portion of this building completely destroyed was that facing Wellington St. and extending back about 50 ft. Adjoining the rear portion was a 50- by 75-ft addition, 5 storeys high, which was also protected with water curtains at the windows that overlooked a furniture warehouse. Although the warehouse was completely destroyed and the heat from the fire intense, only a few panes of glass were broken in the Kilgour addition. This addition also diverted the flames so that they beat on the side instead of the rear of the Minerva Manufacturing Company's premises on Front St., and to this fact must be given much of the credit for stopping the spread of the fire at this point.

The eastward advance of the fire on the north side of Front St. was stopped at the Minerva Building, 12 Front St. (Figure 6). On the south side of Front St. nothing interfered with its progress, all the buildings up to and including the premises of McMahon, Broadfield and Co. (wholesale crockery dealers) were destroyed. This point marked the extreme eastern limit of the fire, a space of about 25 ft separating the last mentioned building from the Customs House and examining warehouse, neither of which were damaged. The Customs House had been chosen as one point for a last stand but so overcome were the firemen by heat and smoke that for a time it appeared as though the vantage point had been selected too late; they hung on, however, and made a desperate stand at the Minerva Building to stop the eastward spread of the fire. The fire had spread south by this time to the wharves on Lake Ontario and boats had moved out into Toronto Bay for safety.

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At 5 a.m. 20 April, the fire was still burning fiercely, but was under control, although flames were bursting forth, as though unquenchable, from some buildings within the fire-swept area. Bay St., south of Melinda St., was in ruins and Wellington St. from York St. east to almost Yonge St. was piled high with debris. Buildings on Front St. were gutted from the Queen's Hotel to the old McMaster Building, 12 Front St., next to the Bank of Montreal on the corner of Yonge St. All south of Front St. lay in ruins. On some streets heaps of smouldering debris and brick littered the pavements. On others, so intense had been the heat that great hummocks of cracked asphalt had piled up and broke under the tread of feet. Poles carrying wires had burned and toppled into the streets adding to the chaos. In spite of the extent of this fire, no person was killed, although 25 men were injured.

CONSTRUCTION OF BUILDINGS AND DAMAGE

The construction of the buildings was typical of the mercantile occupancies of that time. All the buildings were of brick construction with the exception of the McLaughlin flour mill, at the corner of Bay St. and the Esplanade, which was built of stone. Ordinary wooden joist construction prevailed with the buildings having flat roofs, covered mainly with gravel. Practically all of the buildings had skylights constructed of light metal frames with thin glass installed in them. The exposed side and rear windows were as a rule not protected. The average thickness of the walls above the foundation was 18 in.; the average height of the buildings was 4 storeys and the average ground floor area was approximately 5000 sq ft. Prior to the fire these buildings had been a most imposing sight (Figures 7, 8) due in part to the massiveness of their masonry walls. In fact, this district had been the pride of the city with more wealth concentrated in these few blocks than in any other area in the city.

There were weaknesses, however, in these buildings, of which the spreading fire quickly took advantage. The most important construction

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weakness was the lack of protection for vertical openings between floors. In many of the buildings there were open elevator shafts, stairways, lightwells and belt holes. Riddled by such unprotected vertical openings, the fire once started, would quickly spread throughout a building. Instead of each storey being a separate compartment, a whole building was essentially one large compartment. In almost all of the buildings, due to the nature of their business, which was mainly mercantile, there were large quantities of combustible materials. In most of the buildings there were therefore formidable fire loads (30 to 50 lb/sq ft) which undoubtedly tended to prolong the duration of fires in these buildings. In addition, the combustible material was available in many of the buildings not only as bulk fuel but also as tinder and kindling. Tinder, for example, was often available in the form of paper, and kindling in the form of veneers. When fuel is available in these latter forms a fire will tend to develop more rapidly, which gives credence to many accounts that fires quickly involved a whole building.

Almost all combustible material, such as wooden cornices, window trimmings, floors and roofs, was consumed. The majority of masonry walls fell down but rows of bare cast-iron posts remained in place, a number bent or broken. Unprotected steel and wrought iron I-beams and posts were bent and twisted (Figure 1). Stone columns and posts were badly spalled and scaled so as to render them unsuitable for future use.

Figure 9 shows the severe damage suffered by the massive masonry buildings shown in Figure 7. Undoubtedly the lack of effective compartmentation between storeys due to inadequate fire resistance of floor assemblies and absence of protective enclosures at vertical openings was the major construction deficiency.

During the Toronto fire 98 separate buildings were destroyed. The total area covered by the fire was 19.7 acres, including 4.4 acres of street allowances, leaving the total block area of the conflagration at

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15.3 acres. The lack of adequate compartmentation between floors allowed whole buildings to become exposing sources which automatically made spatial separations quite inadequate. This feature was the most important single factor responsible for that conflagration.

FIRE SPREAD BETWEEN BUILDINGS

Although fires spread across narrow lanes between buildings with unprotected window openings, they also spread across streets with widths of 66 and 78 ft. The spread of fire between buildings has been a subject of much study, particularly of late, and many modern building codes such as the National Building Code of Canada have modified their spatial requirements to cater to this problem. Two examples have been worked out for buildings involved in this fire using the spatial separation tables given in the National Building Code. The values obtained have been based on the assumption that no construction separation was required between floors. One example, concerns the Currie Building, 58 Wellington St. in which the fire originated. In this instance the front face of the building would be required by the National Building Code to be 45 ft from the lot line. In other words, the Currie Building would have to be spaced 90 ft from the building opposite it across Wellington St. as compared to a street width of 66 ft. Another example is the building which was situated at 38-36 Front St. In this case, due to the occupancy, the front face would be required by the National Building Code to be 58.5 ft from the lot line or 117 ft from the building opposite. (The actual distance between buildings was only 78 ft.) These spatial separations are based on the fact that the occupancies would be classed in the National Building Code as having a high fire load. Even these values, however, are not sufficient to eliminate the spread of fire indefinitely. They were established on the basis that fire department equipment would arrive at the scene of a fire and effective fire fighting would commence before maximum radiation levels could be obtained.

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OCCUPANCIES

The Toronto fire occurred in the centre of the mercantile area which accounted for the large amount of combustible material contained in the majority of buildings. Table I lists the concerns burned out classified in accordance with the business carried on.

DAMAGE TO CONTENTS

During the fire much of the combustible contents of buildings was consumed. Some interesting points regarding damage to the contents of buildings are provided in the report of the General Committee of Fire Insurance Co. on the Toronto Conflagration. The Underwriters' Salvage Co. of New York was engaged to assist in the handling of salvages. A storage and drying department was established in the upper floors of the Toronto Brewing Company's premises and a sorting yard on Wellington St., each in the charge of a full staff of assistants. Of the 41 ruins examined, only ten were found to yield anything that would warrant the expense of handling, namely seven wholesale dry goods stocks, two wholesale hardware stocks and one wholesale fur stock. The dry goods stocks proved the most remunerative, particularly the salvage taken from the premises of the W. R. Brock Co., Limited, where a considerable amount was found in the underground areas. This was a sprinklered building, and it is thought that the quantity of water distributed upon the merchandise accounts for the comparatively large salvage. The hardware stocks were in very bad shape, hardened steel tools, gun and rifle barrels and heavy shelf hardware being found in solid masses, sometimes of several tons weight. The salvage of the fur stock was not large and was only in fair condition.

Such salvage as was found was generally in the neighbourhood of the outbreak of the fire. As the fire worked southward it gained in heat intensity, presenting as a result a completeness of combustion rarely seen even in major conflagrations. On Front St. the heat was so great that it was impossible for the firemen to approach the buildings, and

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almost no water was thrown on the premises south of this point. This is clearly shown by the condition of the ruins - practically no salvage was found in this locality.

From one or two accounts it would appear that the vaults used for the protection of records functioned quite well. Fergus Kyle in his article "Incidents at a Great Fire," Canadian Magazine, 1904, touched briefly on this part. "There was an urgent call for experts to open the safes and vaults, and the local company, as well as those from elsewhere, had men at work as soon as the temperature of the bricks would permit. When the oven was opened, and, as in most cases, the batch was found to be not overdone, the waiting clerks busied themselves with passing out the books and papers, knocking and blowing the dust from them...."

FIRE APPARATUS AND WATER SUPPLY

The number and size of water mains in the fire area were as shown in Table II.

There were 21 hydrants within the area of the conflagration, with 4 hydrants immediately adjacent to the premises in which the fire originated. They were mainly 2-way hydrants although some were 3- and 4-way. The water pressure at the hydrants within the area of the conflagration varied from 70 to 80 psi. In all, some 50 streams were running and the running pressure would be represented by about 50 per cent of the above figures, or say an average pressure of $37\frac{1}{2}$ psi. This pressure would be further-reduced owing to the breaking or melting of service pipes in the buildings destroyed. The service pipes would vary from 1/2 in. to 4 and 5 in.

In the report on this fire by the Toronto Fire Department, reference is made to a news item, dated 7 October 1904 in <u>The Toronto</u> <u>Globe</u>, which states that Toronto's City Council had earmarked \$1,150,000 to be spent on improvements and additions to its waterworks and was considering the further expenditure of \$850,000 for still greater protection against fires. The report also states that one of the results of the Toronto fire was the installation of the high pressure system which began operation in 1909.

The report of the General Committee of Fire Insurance Co. contains an inventory of the equipment and apparatus held by the Toronto Fire Department at the time of the fire. The total force of the Department including officers and men was 196. The Department had the following apparatus fully manned and equipped:

- 5 steam fire engines
- 1 65-ft "Champion" water tower (One is shown in action in Figure 10)
- 1 86-ft aerial turn-table hook and ladder truck and portable water tower combined
- 1 65-ft aerial turn-table hook and ladder truck
- 5 city hook and ladder trucks
- 2 four-wheeled, two-horse chemical engines
- 1 four-wheeled, two-horse combination hose and chemical
 engine
- 15 hose wagons, with fire extinguishers attached
- l hose cart
- 1 salvage wagon with 4,320 sq ft of rubber covers
- 1 supply wagon

This report also itemizes the quality and condition of the fire hose in use at the time of the fire (Table III).

Information on alarms and apparatus responding is given in the same report. The first alarm was given at 8.04 p.m. from Box 12, corner of King and Bay St. to which the following apparatus responded: 7 hose sections, 3 engine sections, 1 aerial truck, 1 hook and ladder truck, 1 water tower and 1 salvage wagon. A general alarm was sounded at 8.51 p.m. calling out all sections. Outside assistance was requested about 10.30 p.m. Table IV provides information on the type of assistance received and when it arrived.

SPRINKLER SYSTEMS

Three of the buildings in the fire area had sprinkler systems. These were the Brock, Kilgour Bros. and the Evening Telegram Buildings. It is interesting to compare the operation of these various systems during the fire since they all played a valuable role. The Brock Building had both inside and outside sprinkler systems with the inside system being fed from both a gravity tank and city water and the outside system from city water only. The outside system prevented the fire from entering the building until the pressure in the city mains dropped, allowing the fire to gain entry at the upper floors. The inside system then functioned and held the fire in check until the gravity tank was empty. This building, which was in the centre of the conflagration, remained free of fire long after its neighbours were well involved.

The inside sprinkler system, installed in the Kilgour Bros. Building, was supplied by two gravity tanks and city water and the outside system by city water and an auxiliary steamer connection. As in the case of the Brock Building, decreased water pressure in the city mains eventually made the outside system ineffective at the upper floors. With the larger tank supplies, the inside system held the fire in check. The outside system protecting the windows of the 5-storey addition prevented the fire from gaining entry in spite of the fact that this addition faced a furniture storage warehouse that had been completely destroyed.

Although the Evening Telegram Building had a sprinkler system, the fire was successfully fought with the hose connected to standpipes, and no heads opened. In this instance, as with the Kilgour Building, the buildings were on the edge of the conflagration and not in the centre as in the case of the Brock Building.

AUXILIARY FIRE-FIGHTING AIDS

It is evident from many reports that various types of firefighting equipment were used during the Toronto fire. For example, J. William Gerred, writing in <u>The Toronto Globe and Mail</u>, 17 April 1954, states: "I think the (Queen's) hotel was saved by sentiment. The staff, the guests and the public at large all pitched in to save the Queen's. It was a hot, long, drawn out battle in which every resource was used: pots, pans, pails, hand hoses plus hundreds of blankets that were spread over every vulnerable spot."

As is often the case during conflagrations, consideration was given to the use of dynamite. The Toronto Fire Department report states: "Although flames had already leaped across sixty-six foot streets, the use of dynamite was considered and Mayor Urguhart granted permission to Deputy Chief Noble to blast a fire break. Stanley Barracks detailed a detachment of engineers to do the job but as dynamite could not be located, the plan was abandoned and the soldiers remained to assist the police in controlling the crowds." It is probably fortunate that dynamite could not be found as in most instances where it has been used, the effect has been to spread the fire rather than confine it particularly in the presence of a high wind.

FINANCIAL LOSSES AND INSURANCE RATES

The total value of the property destroyed was estimated to be \$10,350,000 (present dollar value \$36,500,000). Of this amount about 20 per cent was represented in buildings and about 80 per cent in contents. Besides property loss it was estimated that 6000 employees were thrown out of work.

The report of the General Committee of Fire Insurance Companies states: "The total loss sustained by companies represented in this committee as shown by statements obtained from each office was \$8,200,000. Estimating the losses suffered by unlicensed companies at

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\$175,000, the total insurance loss would appear to be \$8,375,000 or 80 per cent of the total value of property destroyed. The percentage of insurance to value on buildings was about 65 per cent and on contents about 85 per cent. The 75 per cent co-insurance clause was operative under the rules of the Toronto Board of Fire Underwriters on both buildings and contents and was found in nearly all policies."

As a result of this heavy loss the Canadian Underwriters Association immediately advanced insurance rates in the downtown area of Toronto by 75 per cent, and those in outside districts by 40 per cent. Only rates on dwellings were not affected.

The schedule of rates adopted for Toronto and made retroactive to 12 p.m., 19 April, the date of the fire, was as follows:

Congested district - On all mercantile schedule and other specially rated risks, add \$1 to rate.

Outside district - On all risks except dwellings and their contents add 50 cents to rate.

Residential stores - A reduction of 25 cents may be made on these risks in outside districts, with the usual warranty. Where three-year policies are permitted, the extra to be added to the three-year rate.

Sprinklered risks - fireproof buildings and contents - Half the foregoing extras to be added to rates on these risks.

Co-insurance - A reduction of 15 per cent from rate on buildings and 10 per cent on stocks may be allowed for the 80 per cent co-insurance clause.

Similar increases were applied in nearly all Canadian cities.

COMPARISON WITH OTTAWA-HULL FIRE OF 1900

A comparison of various features of the Toronto fire and the Ottawa-Hull fire of 1900 reveals a number of marked differences and a few, but important, similarities. A study of Table V, which compares weather conditions at the time of these fires, shows a marked difference in air temperatures although these fires occurred at the same day of the year within a week. Their one common feature, a strong wind from the north, was most important. In both cases it channelled the fires towards sparsely occupied areas, thus allowing fire-fighting efforts to be successfully concentrated on the flanks of the fire. On the other hand, at both fires also, the wind undoubtedly increased the size of radiating flames on the leeward side of buildings, thereby increasing the exposure hazard. In the Ottawa fire, flying brands formed from burning wood shingles and borne by the strong wind greatly influenced the extent to which the fire spread.

The types of construction involved in the two fires varied greatly, almost all of them having serious structural defects from the standpoint of conflagration hazard. In Ottawa and Hull the vast majority of the 3200 buildings destroyed were wood frame houses, having wood shingle roofs. The other buildings involved were mainly industrial and commercial buildings. These latter buildings were almost all of wood joist construction, many of them being built entirely of wood, with no protection of vertical openings in the multi-storeyed buildings. The buildings involved in the Toronto fire were on the average 4-storey brick buildings, having about 5000 sq ft of floor space on each storey and were used for mercantile purposes. They had wood joist floors, skylights, open vertical shafts with large windows across both front and back.

Five contributory conditions for conflagrations are listed in reference 1 of which 4 are concerned with construction. These four conditions are described as follows:

1. contiguity of frame buildings;

2. prevalence of combustible roof coverings;

the extension of many fires has been due to the shingles released from burning buildings being carried by heated air currents to ignite distant buildings.

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3. individual buildings of large area or excessive height, situated in congested districts, and so constructed that intense internal combustion is rapidly set up; these may be low 1-storey buildings of unbroken area, such as the wharf warehouse at New Westminster, or modern 6-storey buildings with numerous vertical openings that permit combustible goods on each floor to ignite almost simultaneously.

4. lack of firebreaks, such as solid brick walls and window protection; gases and superheated air cannot be confined within a burning building and, under certain conditions, jets of flame issuing from window openings and doorways may set fire to structures at a considerable distance.

In general, conditions 1 and 2 were the major factors in the Ottawa-Hull fire, and conditions 3 and 4 in the Toronto fire.

In both fires, installed water systems such as interior sprinkler and standpipe systems and exterior water curtains played an important role. One example of this in the Ottawa-Hull fire was a water system that had been installed in the J. R. Booth Sawmill. This sawmill was situated adjacent to lumber piles that were all burning, yet it survived because of the water system. From the meagre information available it would appear that there was a crude sprinkler system installed as well as a number of standpipes, all supplied by Booth Co. pumps operating from the Ottawa River. Much of the credit for saving the mill must be given to the use of hand lines operated by mill employees.

In the Toronto fire there were three buildings with sprinkler systems, one also having a standpipe system. In the case of the Brock Building, while the sprinkler system functioned effectively as long as water was available, it is problematical whether this building, which was in the centre of the conflagration, could have been saved even if adequate water had been available. At the Kilgour Bros. Building, which was on the flank of the fire, it would appear that the sprinkler systems (both inside and outside) enabled the fire fighters to stop the fire at this point. Although the Evening Telegram Building, also on the flank of the fire, had a sprinkler

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system installed, no heads opened, as employees using hand lines from standpipes were able to control the fire spread in the building.

The municipal water systems in both fires were severely taxed, but enough water was available to allow the fire fighters to exert some control at the flanks of the fire. Although no accurate figures are available, it is estimated that in the Toronto fire $2\frac{1}{2}$ to 3 million gallons of water were applied during the 9-hour period prior to the fire being brought under control. During the Ottawa fire, it is unlikely that more than 1 million gallons of water were applied during the height of the fire.

The Toronto fire was fought by 230 firemen and officers, including outside personnel, having the following major equipment: 5 steam engines, 15 hose wagons and 2 water towers, and 30,000 ft of $2\frac{1}{2}$ -in. hose. The Ottawa fire was fought by 70 firemen and officers, including outside personnel. Equipment used included 5 steam engines (2 from outside), 12 hose wagons and 20,000 ft of $2\frac{1}{2}$ -in. hose. At both fires considerable assistance was given by large numbers of citizens and soldiers, who formed bucket brigades to wet down buildings on the flanks of the fires, and extinguish small fires outside the zone of the main fire.

"Fire Waste in Canada" states: "No conflagration has ever been stopped by organized attempts at extinguishment. The most powerful hose streams are ineffective at more than 150 ft, the exact distance depending upon the velocity of the wind. The horizontal reach of flames driven by a gale, has, in many instances, exceeded 1000 ft, and the buildings over one-half mile in advance of the fire have been ignited. Under such conditions, a fire department can fight the conflagration neither in advance of the flames nor from the rear, because of the trail of hot and burning debris. Operating on each flank of a sweeping fire, the efforts of a fire department are again of doubtful value, being spread over too large an area to permit effective work. Without attempting to disparage the efforts of firemen in dealing with conflagrations, it should be recognized that their chief value has been in preventing flames from spreading across the wind, and in extinguishing brands that have alighted outside the zone of the fire."

In general, the Toronto and Ottawa-Hull fires bear out the foregoing views. In both cases, however, obstacles in the path of the fire on the leeward flank enabled fire fighters to play a relatively effective role in stopping the fire on this flank.

Summary of Losses

Table VI shows the losses involved in both fires.

In the Ottawa-Hull fire 14, 159 people were rendered homeless and a number of industries were destroyed, whereas in the Toronto fire the damage was restricted to mercantile properties. In the case of the latter fire there was 80 per cent coverage by insurance, whereas in the Ottawa-Hull fire there was only 40 per cent coverage, since the majority of homes were not insured. In order to relieve the hardship in the Ottawa-Hull fire a relief fund was set up, the contributions of which amounted to approximately \$1,000,000.

In the Ottawa-Hull fire, the area damaged by fire was 716 acres with over 3200 buildings destroyed, and millions of board feet of lumber consumed. This fire was under control in $13\frac{1}{2}$ hours. The Toronto fire devastated an area of 20 acres, destroying approximately 100 buildings. The fire was under control in 9 hours.

Fire Loads Involved

Table VII shows a comparison between fire loads, building areas and fire areas for the two fires. "Fire load" is the weight of combustibles in pounds.

As can be seen from Table VII, the really significant difference in "fire loads" is that contributed by the lumber piles. In this case the fire would burn for a longer time, and would exert some influence on the spread of the fire in general, both by supplying flying brands and by radiating heat to adjacent structures.

Spread of Fire

In the Toronto fire, the progress of the fire along the various fire fronts ranged from $l\frac{1}{2}$ to 6 buildings per hour depending on a number of factors. Some examples are given below.

1. Fire spread in those buildings located on the south side of Front St., east of Bay St. to the eastern limit of the fire was at the rate of 6 buildings per hour. The spread was across the short dimensions of the buildings and in the direction of the wind.

Fire spread in those buildings located on the north side of
 Front St. east of Bay St. to the eastern limit of the fire was at the rate of
 buildings per hour. The spread was across the short dimensions of the
 buildings and in the direction of the wind.

3. Fire spread in those buildings located on the east side of Bay St. from No. 43 Bay St. to Wellington St. was at the rate of 3 buildings per hour. The spread was across the short dimensions of the buildings and against the direction of the wind.

4. Fire spread in a southerly direction on those buildings located on the north side of Wellington St. (Nos. 56 and 54) to those located north of the Esplanade was at the rate of $1\frac{1}{2}$ buildings per hour. The spread was generally across the long dimensions of the buildings and in the direction of the wind. In addition the fire had to spread across several spatial separations.

5. Fire spread in an easterly direction from the Currie Building to the buildings on the east side of Bay St. was at the rate of $2\frac{1}{4}$ buildings per hour. The spread was across both short and long dimensions of buildings in the direction of the wind. A correction has been applied in calculating the spread across the short dimensions. In addition the fire had to spread across spatial separations.

6. Fire spread in those buildings located on the west side of Bay St. from No. 46 to Wellington St. at the rate of $4\frac{1}{2}$ buildings per hour.

The fire spread was across the short dimensions of the buildings and against the direction of the wind. In this instance, the buildings already burning on the east side of Bay St. exerted an influence which explains why the rate of progress is intermediate between the values with and against the wind.

In the Ottawa-Hull fire the only area for which information about the progress of the fire along a fire front was available was the residential area lying between Wellington St. and the Macadamized Road (now known as Carling Ave.). The fire spread through this area in 7 hours. An estimate has been made of the progress of the fire fronts through rows of buildings facing the two streets immediately adjacent and west of Division St. In one row it was assumed that there were 44 houses with their short dimension in the path of the fire and 28 houses with their long dimension in its path. In the other row it was assumed that there were 20 houses with their short dimension in the path of the fire and 36 houses with their long dimension in its path.

If R_1 buildings per hour is the rate of spread for buildings with their short dimension facing the fire and R_2 buildings per hour is the rate of spread for buildings with their long dimension facing the fire then R_1 and R_2 may be estimated from the following equations:

$$\frac{44}{R_1} + \frac{28}{R_2} = 7 \text{ hours} \qquad \qquad \frac{20}{R_1} + \frac{36}{R_2} = 7 \text{ hours}$$

therefore $R_1 = 18$ houses per hour

 $R_2 = 6$ houses per hour

During this fire it would appear that the fire spread in the residential area of Ottawa was three times faster through houses whose short dimensions were facing the fire than through those whose long dimensions were facing the fire. This difference was probably accounted for by the greater spatial separations afforded by rear yards than side yards. The high rates of spread are probably due to the almost universal use of wood shingle roofs together with a high wind that prevailed at the time.

In the above calculations it has been assumed that the two fire fronts acted independently whereas they may well have been interrelated. If this assumption is wrong, then the only comment that can be made is that the fire spread at the rate of 9 buildings per hour.

In both the Toronto and the Ottawa-Hull fires wind was an important factor. Once the extent of the fire became such that it overcame the efforts of the rather meagre fire-fighting forces to confine it, the fire spread freely in the direction of the wind until it ran out of readily available fuel. The only favourable factor was that on the leeward flanks of both fires there were obstacles in its path that enabled fire fighters to stop the spread at these points. In the case of the Ottawa-Hull fire there was the escarpment on the eastern flank separating the remainder of Ottawa from that portion on fire, whereas in the Toronto fire these obstacles were in the form of sprinklered or large solid masonry structures.

CONCLUSION

In the author's opinion, it is most improbable that similar conflagrations could occur today in these two urban centres under normal peace time conditions. Improvements in building regulations and the maintenance of well-equipped fire departments provided with excellent municipal water supplies are such that it would be very difficult for fires involving more than a few buildings to develop. The virtual elimination of conflagrations in large urban centres on the North American continent has been one of the major achievements in the field of fire protection during the first half of the 20th century.

ACKNOWLEDGEMENTS AND REFERENCES

The author wishes to thank the National Fire Protection Association and the staff of the Public Archives of Canada for their help in securing, and their generosity in lending, photographs to illustrate this report.

The following books and publications were used as references in the reporting of this fire:

- Fire waste in Canada by J. Grove Smith. Commission of Conservation, Canada, Ottawa, 1918.
- Toronto conflagration. General Committee of Fire Insurance Companies, Secretary's Report. British American Assurance Co.
- Conflagration at Toronto, Ontario. Bulletin No. 76, National Fire Protection Association, May 19, 1904.
- A report on the Toronto fire 1904. Toronto Fire Department, Toronto, Ontario.
- Incidents at a great fire by Fergus Kyle. The Canadian Magazine, Vol. 23, 1904, p.136-140.
- Toronto's great fire by Norman Patterson. The Canadian Magazine, Vol. 23, 1904, p. 128-135.

Toronto romance of a great city by Katherine Hale. p. 174-5.

Ottawa-Hull fire of 1900 by G. W. Shorter. National Research Council, Division of Building Research, Ottawa, June 1962. Fire Study No. 7 (NRC 6802).

Information was also obtained from the following newspapers:

Ottawa Citizen. 20-21 April 1904.

Toronto Globe and Mail. 17 April 1954. Sentiment saved popular Queen's Hotel in big 1904 fire by J. William Gerred.

TABLE I

OCCUPANCIES INVOLVED IN THE FIRE

Nature of Business	No.	Destr	oyed
Boots and Shoes (Wholesale)		9	
Clothing Manufacturers		9	- ×2
Drugs, Chemicals, Photo Goods and Oils		9	
(Wholesale)			
Furs, Hats and Caps (Wholesale)	$+\infty$	6	
Hardware and Machinery (Wholesale)		8	
Millinery, Smallwares and Fancy Goods		21	
(Wholesale)			
Printing, Lithographing, Book Binding		23	
and Stationery			
Whitewear, Men's Furnishings (Wholesale)		7	
Dry Goods (Wholesale)		24	
Crockery and Lamps (Wholesale)		3	· · · ·
Miscellaneous		18	

TABLE II

WATER MAINS IN THE FIRE AREA

Street	No. of Mains	Diameter, in.
Esplanade	1	6
Bay	1	12
Bay	1	6
Front	1	24
Front	1	12
Wellington	1	12

TABLE III

		Condition	<i>2</i>	
Type of Hose	Good	Medium	Poor	
	ft	ft	ft	
	1000		(50	
1" Chemical	1000		650	
2" Chemical	2500			
$2\frac{1}{2}$	18,900	4450	2250	
311	920	150	50	
$3\frac{1}{2}$ ¹¹	200	50		
Total	23, 520 -	4650	2950	

QUALITY AND CONDITION OF FIRE HOSE

TABLE IV

OUTSIDE ASSISTANCE

Municipality	Apparatus	No. of Men	Hour of Arrival				
Kew Beach	500 ft hose	10	10.45 p.m.				
Toronto Junction	500 ft hose	8	10.45 p.m.				
East Toronto	500 ft hose	8	10.45 p.m.				
Hamilton	1000 ft hose	10	Midnight				
Buffalo	2 engines 2 hose wagons (did not unload)	A.	4.30 a.m.				
Brantford	l engine, arrived	too late for se	rvice				
Niagara Falls	l engine, arrived	l engine, arrived too late for service					
London	l engine, arrived	l engine, arrived too late for service					

TABLE V

WEATHER CONDITIONS

Fire	Date	Time of Origin	Weather Conditions
Ottawa-Hull	26 April 1900	10.30 a.m.	63°F, balmy spring day, snow gone, wind from north up to 30 mph.
Toronto	19 April 1904	8.00 p.m.	24°F, cloudy, snow- flurries, wind from northwest 25-30 mph.

TABLE VI

FIRE LOSSES

Fire	No. of Bldgs. Destroyed or Severely Fire Damaged		Insurance	Life Loss
Ottawa-Hull	Over 3200	9,515,849	3,855,595	7
Toronto	100	10,350,000	8,375,000	0

TABLE VII

FIRE LOADS

	Toronto Business District	Ottawa Res.	Ottawa Ind.	Ottawa Lumber Piles	Ottawa Railway Property	Hull Res.	Hull Ind.	Hull Lumber Piles
Fire Load (x 10 ⁶ lb)	64.00	84.00	47.00	635.00	61.0	58.00	13.70	262.00
Bldg. Area (x 10 ⁶ ft ²)	0.51	1.31	1.05	2.1	1.2	0.92	0.30	0.87
Fire Area (x 10 ⁶ ft ²)	0.86	10.80	1.60	3.2	3.7	10.20	0.44	1.30

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Fire Area (x 10 ⁶ ft ²)	0.86	10.80	1.60	3.2	3.7	10.20	0.44	1.30



Figure 1 View of buildings on north side of Wellington St., west of Bay St. following fire. Fire started in 4-storey building (Currie) in centre of photo.

(photograph courtesy Public Archives)



Figure 2 Plan of fire area, showing place where fire started and times (figures in circles) when various groups of buildings were burning. (photograph courtesy N. F. P. A.)



Figure 3 View of south side of Wellington St., west of Bay St. following fire. These buildings were opposite the Currie Building where fire started. (photograph courtesy Public Archives)



Figure 4 The fire swept up Bay St. to some low buildings next to the Toronto Engraving Co. These low buildings enabled the firemen to stop the northward progress at this point. (photograph courtesy Public Archives)



Eastern limit of fire on south side of Wellington St. Note water tanks (photograph courtesy Public Archives) on roof of Kilgour Bros. Building. Figure 5



Figure 6 The Minerva Building which barred the progress of the fire on the north side of Front St., near Yonge. (photograph courtesy Public Archives)



Front St. At right side of photograph is building occupied by Barber and Ellis Co. to which fire spread across Bay St. around midnight. (photograph courtesy Public Archives)



to one across which fire jumped early in its history. All buildings shown view of type of building destroyed. Also showing a narrow alley similar North side of Front St. showing Buildings nos. 26-42 inclusive. A good in this view are entirely gone.

(nhotograph courtesv N. F. P. A.)



The Bay St. after the fire (approximately same view as in Figure 7). impressive masonry buildings now lie in ruins. (photograph courtesy Public Archives) Figure 9



Figure 10 Corner of Bay and Wellington St. - water tower at work. (photograph courtesy Public Archives)