The Saint John fire of 20 June 1877

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The twentieth of June 1877 was dry and hot in Saint John. For several days the temperature had hovered between 75 and 80°F. The inhabitants welcomed a brisk wind from the northwest which provided some relief from the heat. At 2:30 p.m. on that Wednesday, a fire broke out in a wooden building at York Point, Portland. Although the fire department arrived within a few minutes of the alarm being sounded, the fire had already spread to a building next door. The resulting conflagration destroyed several hundred buildings causing property damage estimated at $27,000,000 and was responsible for the death of 18 people. Almost the entire business and commercial area together with several hundred dwellings were destroyed. Many public buildings, churches, wharves, warehouses and ships were also lost. The fire covered approximately 200 acres bordered on the west by the Saint John Harbour and by Courtenay Bay on the east.

DEVELOPMENT OF THE CONFLAGRATION

The fire began in a wooden building located on York Point Slip belonging to a Mr. Fairweather (Figure 1). How the fire began is not known but once started it spread very rapidly. Within three minutes after the alarm was sounded, Engine No. 3 was throwing water upon the ignited buildings. Other engines followed immediately, but before they could find a suitable location to play water upon the flames, the fire had spread by means of sparks and radiated heat to a score of wooden structures.

The fire quickly involved Smyth Street and spread south to South Wharf (Figure 2) involving Nelson Street and Robertson Place. At the same time, it spread into Drury Lane, Mill Street and Dock Street. The Saint John firemen assisted by Carleton and Portland firemen, who came with their engines, attempted to hold the fire at Union Street near Drury Lane. Unfortunately, houses past this point on Union Street caught fire and forced the firemen to retreat. In spite of great personal discomfort the firemen eventually held the fire in Union Street at the next block, east of Dock Street. This was the key to saving the part of the city lying north of King Street.

The buildings facing Market Square (Figures 3 and 4), including the Maritime Block (Figure 5), soon caught fire. At the northeast corner of Market Square stood the building that housed the wholesale establishment of Daniel and Boyd. This building was soon destroyed but another structure two doors away remained standing (Figure 6) and helped to prevent the fire from spreading on the north side of King Street (Figure 7). The building housing the Bank of British North America also survived and helped to prevent the fire from spreading north on Prince William Street. The fire spread across Market Square into Water (Saint John) Street and Ward Street. A slip full of schooners and wood boats was destroyed.

The fire entered the southern side of King Street from Germain and Canterbury Streets (Figure 8). It swept down the south side of King Street destroying several wood structures as well as the Pine Building, the only brick building between Canterbury and Germain Streets. Crossing Germain Street the fire continued to destroy buildings including Hall's twin

buildings constructed of stone at the corner of King and Germain Streets. No buildings on the south side of King Street up to and including the United States Hotel (formerly the Saint John Hotel) were spared. This hotel faced King Square at the corner of King and Charlotte Streets.

The fire spread south along Germain Street destroying Foster's Corner at the intersection of Germain and King Streets. After destroying several buildings on the west side of Germain Street it crossed to the east side attacking "Old Trinity" church (Figure 9). "Old Trinity", a Saint John landmark, has been built in 1791 and had a seating accommodation for 1000 people. It was destroyed so quickly that there was barely time to save the historic Royal Arms. The fire continued down Germain Street until it reached the old "Germain Street Methodist" church at the corner of Horsfield Street. This church built in 1808 had since been enlarged to seat 900 people. The Academy of Music, located directly across the street, was burning at the same time. The academy was a (190 ft x 51 ft x 65 ft high) three-storey brick building which cost approximately $60,000 to build and could seat 1,200 people (Figure 10).

Continuing down Germain Street to Duke Street the fire destroyed "St. Andrew's" church, which had been constructed in 1816. Next to be attacked was the massive five-storey Victoria Hotel located on the corner of Duke and Germain Streets (Figure 11). This hotel was constructed of brick and stone in 1871 at a cost of $165,000. Many expressed the feeling that if a fire engine had been available at this location the hotel might have been saved. By this time the fire had spread into and swept down both sides of Horsfield Street. It continued down Germain Street

to the water's edge, burning the Baptist church constructed of brick in 1865. At the same time the fire was spreading in Queen Street and Pagan Place, destroying residence after residence. Simultaneously, it was raging in the lower part of Saint John. The army barracks built in 1819 and located in the Military Ground, Lower Cove burned to the ground before the Victoria Hotel was even attacked. The many wooden houses, built close together influenced the rapid spread of the fire in this area. In Main Street, St. James church, built in 1851, caught fire from a spark and was soon destroyed. In Sheffield Street and Carmarthen Street two wooden mission houses and many dwellings were destroyed. Buildings on Princess, Leinster, Duke, Orange Streets and King Street East were rapidly engulfed by the fire.

It has been suggested that the eastern section of the city became involved as a result of incendiarism. The open King Square had served as an effective spatial separation until late in the evening. In this area old "St. Malachi's" chapel caught fire from sparks coming from Christian Robertson's mammoth stable. The Dramatic Lyceum on King Square was soon destroyed and fire crept around the Square with one wing advancing up Leinster Street and the other attacking the Court House and Jail which were left standing. The office building of the Superintendent of Water Supply at the corner of Carmarthen Street and Leinster Street provided a stubborn defense against the fire. Many people, believing this area would be safe, brought furniture and general chattels and stored them in the yard surrounding the building. The water supply office building, however, was eventually levelled, caught between the fires on Carmarthen Street and Leinster Street. The Saint John Meteorological Observatory was located in this building. (A copy

of the weather observations taken at the observatory around the time of the fire was made available to the writer by the federal Meteorological Service.) After destroying the Water Company's building the fire attacked Leinster Street Baptist church across the street. This wooden structure built in 1864 was soon levelled.

The next public buildings to be destroyed were the brick "Varley Wesleyan" day-school and the "Centenary" chapel at the corner of Princess and Wentworth Streets. This brick church was constructed in 1857. On the same corner were three solidly built residences which slowed the progress of the fire but eventually burned. Fire spread to houses on Princess Street and to the west side of Pitt Street, which was the eastern boundary of the fire. The Gas House on Carmarthen did not ignite until late in the fire. A large coal pile near the Gas House burned for nine or ten days. Although there was 100,000 cu ft of gas in the gas holder that was threatened by flames no explosion occurred. The efforts of the manager prevented such a catastrophe. Both sides of Leinster Street were burned down to Pitt Street. On King Street all of the buildings east of the jail to Pitt Street were destroyed. Buildings on both sides of Princess Street to Pitt Street and those on Orange Street were destroyed. On Sydney Street, two churches, both Presbyterian, were destroyed. The destruction of the newly erected "Victoria" school on the corner of Duke Street and Sydney Street came as a shock to many. This was a four-storey masonry building (erected in 1876 at a cost of $50,000) with a slate-covered mansard roof and a gravel flat roof deck.

During the fire, people sought refuge both for themselves and their goods on Queen and King Squares. On Queen Square, 1,000 people watched the burning of the handsome residences on all sides of the Square (Figure 12). Two buildings stood on St. James Street - the Marine Hospital, an old barn-like structure, and a splendid new orphanage of masonry construction. An irony of the fire was the saving of the hospital and the loss of the orphanage. All the fine residences on Mecklenburg Street were destroyed. The fire in Canterbury Street levelled a number of masonry buildings housing many of the city's leading merchants. The stone Savings Bank on the corner of Princess and Canterbury Streets was destroyed.

All the buildings on Prince William Street, including the old Commercial Bank Building which housed the civic offices (City Hall) and the Bank of New Brunswick, were seriously damaged. The latter building was of heavy masonry stone construction. Although this building was severely damaged, the large quantities of books and money that were hastily brought in during the fire were preserved in the bank's vaults. The destruction of the new Post Office was a sad blow. This building (Figure 13) and the Custom House were destroyed even though they were of heavy masonry construction. Buildings on Water Street suffered severe damage, many being destroyed. Several fine buildings were destroyed in Princess Street from Prince William to Charlotte Street. These included the Wiggins and Ritchie Buildings, both of masonry construction.

The fire died down about nine hours after it started, although piles of rubble smouldered for several days. Two hundred acres were desolate.

CONSTRUCTION OF BUILDINGS AND DAMAGE

The construction of buildings involved in the fire varied greatly. For many years the city had a designated "fire district" which covered mainly the mercantile area of the city (Figure 1). Within this area, buildings built after the fire district was established had to have masonry exterior walls. On the harbour side of the fire district were the slips and wharves with their warehouses and business establishments. To the east and south of the fire district was the residential area. Most dwellings were constructed of wood and had wood shingle roofs. Several large wooden churches were located in the residential area. Of the 13 churches destroyed, 12 were constructed of wood.

In the mercantile area, most buildings were three or four storeys, with brick exterior walls (Figures 3 and 4). The roofs were generally slate although there were a number of flat roofs surfaced with gravel. A number of buildings had mansard roofs sheathed with wood shingles. The buildings usually had open wooden stairwells and wood joist floor and roof systems. Many buildings such as the Bank of New Brunswick, the Custom House and the Post Office had been imposing structures of massive masonry construction. Unprotected openings in these buildings allowed fire to spread rapidly throughout the whole building. Many of the buildings contained large amounts of merchandise; this constituted high fire loads. Another weakness was the exclusive use of wooden door and window frames. These were often the first items ignited.

A row of typical buildings in the wharf area may be seen in Figure 2, which shows South Market Wharf. These were masonry buildings with parapeted party walls and slate roofs with access

openings in them. Inadequate interior separations allowed fire to develop in these buildings as if they were one large compartment. There were also a number of wooden buildings in this area. Much combustible material was stored in the buildings and on the wharfs. At the time of the fire there were a number of wooden ships tied up at the slips. Following the fire all that remained in the residential area were brick chimneys. In the mercantile area, only shells of masonry buildings remained. Sixteen hundred dwellings had been destroyed.

FIRE SPREAD BETWEEN BUILDINGS

Much of the fire spread between buildings was caused by flying brands. In R. H. Conwell's book History of the Great Fire in Saint John (1) two passages vividly depict this situation. The first passage describes conditions early in the development of the fire.

"The wind was blowing in a hurricane, and fanned the furnace behind them until with volcanic throes it belched forth burning brands of pine which a strong man would have found it difficult to carry, and, shooting them high in the heavens, let them fall far to the windward, crashing into roofs and windows, or threatening the lives of the crowd, about whose heads they whirred and hissed as they fell to the pavement. So hot became the gusts, and so full of sparks was the air everywhere in the path of the tempest, that bundles of goods tossed from second-storey windows were on fire before they reached the hands of those who caught them in the yard below."

The second passage describes conditions as the fire spread to various parts of the city.

"At that time the whole water-front upon the river side of the city was on fire. The conflagration had spread in a most unusual and astonishing manner. For while the original flames were coursing down Dock and Nelson Streets, and demolishing the structures on Market Wharf, live coals were carried long distances, and dropped into tarred roofs, or bales of hay, or slyly inserted by the wind under casings, shingles, or shavings, to spring up into hundreds of bonfires wholly unexpected, and consequently wholly at liberty to grow into wildfires without obstruction. In this way the large establishment of Daniel and Boyd on Market Square was ignited. In this way the wooden buildings half a mile distant and near the Custom House were set on fire. So that it was the work of but a short space of time, not exceeding forty-five minutes after the fire was in Dock Street, before the whole of the city lying between Prince William Street and the water was burning nearly as far down as Reed's Point."

Undoubtedly the fire spread from building to building by radiation as well. Two examples have been worked out for buildings involved in this fire using the spatial separation tables given in the National Building Code and also the more detailed original tables on which the latter were based. The values obtained have been based on the assumption that no construction separation existed between floors. Considering the Victoria Hotel (Figure 11), which was located on the corner of Duke Street (60 feet wide) and Germain Street (70 feet wide), the National Building Code and the original tables specify that adjacent buildings should not be closer than 78 feet and 83 feet, respectively. As a second example, the building fronting on King Street shown in Figure 6, although not itself involved in the fire, has been considered typical of those on the opposite side of the road.

On the assumption that the buildings burned successively, the National Building Code and the original tables specify, respectively, that adjacent buildings should not be nearer than 62 feet and 55 feet. If several buildings burned simultaneously at their peak rate, the recommended separation given by the original tables could rise as high as 114 feet. It is unlikely that this occurred. King Street was 110 feet wide and none of the buildings on the north side ignited, whereas all the buildings surrounding the Victoria Hotel did so. The spatial separation recommendations are thus consistent with the two examples specified.

OCCUPANCIES

The Saint John fire spread rapidly in the wharf area, where there were many warehouses. It then spread into the business and mercantile district, involving a large number of buildings containing large quantities of combustible goods. Table I lists the occupancies (including 20 manufacturing plants) which were involved in the fire.

DAMAGE TO CONTENTS

In general, very little was salvaged from the buildings involved in this fire. This applied both to household goods and to stocks of merchandise and furnishings in stores, office buildings and warehouses. Attempts were made to save some items by hauling them away to a place thought to be safe. Most places considered safe from the fire proved not to be so later in the day. For example, during the late afternoon, load after load of furniture, merchandise and general chattels was brought into the building housing the office of the Superintendent of Water Supply and the yard surrounding it. Unfortunately, during the evening the fire spread to this area and consumed these goods.

The question of salvage was discussed in the Canadian Illustrated News, July 7, 1877 (2): "Leaving for the present the question of perfecting the Fire Brigades, we remark that at St. John there does not seem to have been any organized salvage corps, nor is there any in more than a very few cities. How well it would pay the companies to see to this, will be more evident, when it is remembered that insured goods, on a fire breaking out, become virtually their own property -- seeing that their responsibility is measured by their value -- and the work of these trained and organized salvage men has a two-fold if not a three-fold value, for they are not only able to remove the threatened goods to a place of safety, but they may often save the structure itself by removing out of it, its more combustible contents, and making a clear way for the firemen; while they can assist the police in clearing the premises, if need be, of those who could do harm and not good."

Among the stocks burned it was estimated that 50 - 60,000 barrels of flour had been burned - nearly all the flour in town. The huge coal pile belonging to the gas company was destroyed. Furniture warehouses such as Stewart and Whites and Lordly, Howe and Co. reported complete losses. There were one or two instances where items were saved. For example, many merchants hurriedly placed their books and money in the vaults of the Bank of New Brunswick. Although the structure was severely damaged, the vaults preserved their contents. George Stewart, in his book "The Great Fire in St. John, N.B.", (3) cites another example: "During the fire and unable to hire a team at any price, they dug a deep hole in the cellar of the house and buried there what jewelry, silver-ware they could scrape together. They were now hunting for it, and eventually they found it, in not even a discoloured state."

One of the more serious losses was that of books and pictures. Although there were no public libraries or art galleries there were a number of very valuable private collections, all of which were lost.

FIRE APPARATUS AND WATER SUPPLY

Conwell (1) has nothing but praise for the fire department. He states, "Although their efficient chief (Thomas Marter) who for so many years had directed their movements, was absent from the city, yet so thorough was their discipline, and so earnest was their desire to be of service, that all their work was done with the most commendable promptness and precision." Under Chief Marter were three District Engineers supervising Engine Companies No. 1, 2 and 3, Hose Companies No. 1, 2 and 3, and Hook and Ladder. The total strength of the Fire Department was 59 officers and men. The Department had 4 steam fire engines, several hose wagons, a hook and ladder truck and 1 coal wagon.

Early in the development of the fire, Portland and Carleton firemen arrived with two engines to assist the city firemen. Much praise is due these men, as pointed out in Stewart's book (3): "The contingent of firemen from Portland worked with a will and did much to check the flames -- as much, indeed as mortal man could do in a fire like this, with a high wind blowing a perfect gale all the time."

As a result of the fire, two thirds of the fire alarm system was destroyed. The first fire alarm installation was in 1867. All the watering carts, slovens, hose etc. belonging to the corporation were burned. No. 1 engine-house was destroyed and No. 2 engine-house was slightly burned.

A description of the development of the Saint John water supply system is included in Appendix A - Early Fire History. It is interesting to note the difference in opinion regarding the adequacy of the water supply system. Stewart (3) states: "A good deal of nonsense, during the excitement of the present fire, was talked about an inadequate supply of water to meet the wants of the exigency, but this was found to be fallacious. There was plenty of water all the time, and while there was much reckless and needless waste, there was sufficient of the element to meet the demands of the firemen and hose-men. It is a popular cry to raise at a fire which cannot be got under way, that there is no water. On the best authority the writer is happy to be able to place it on record that the supply of water was in every way adequate to the requirements of the hour."

Conwell (1) on the other hand has a somewhat different opinion: "But the few buildings which were left at the water's edge were so accessible to the steam fire-engines, and the force of the aqueduct was so great at these low points, that water was to be had in abundance. So many people had opened the faucets in their houses, and were using their hose so generally when the fire approached the principal streets, that the supply on the highest portion of the mountainous city ran short for the fire-engines. The water would scarcely flow while the fire raged the fiercest, so great was the quantity taken and wasted by the people. But in the lower and outlying districts there was water in abundance, and buildings there could be saved."

AUXILIARY FIRE FIGHTING AIDS

A great deal of auxiliary fire fighting was undertaken. On every roof in King Street, clerks and employers worked with

hose and buckets of water, but little that they did delayed or prevented the spread of the fire. One man tried to save a house by standing on the roof and throwing water from a pitcher on sparks as they caught vulnerable spots. For an hour or more he stood there with his pitcher until it became evident that no effort that he could make would save the building. He got down, leaving the pitcher standing on a ledge of the chimney. The fire shortly afterwards burned the building, and left the tall chimney standing against the sky. The next day when people walked over the heap of ashes that had once been a household, they saw the old pitcher, standing on the ledge of the chimney.

On St. James Street stood two buildings. The Wiggin's orphanage was a massive and beautiful structure. The Marine Hospital was an old wooden barn-like building that had been decaying for years and was only waiting to be blown down by some passing wind. The Marine Hospital situated a stone's throw from the massive Wiggin's Orphanage, was built in a garden. When the fire approached, the superintendent and a few of the inmates stationed themselves in good positions and began a vigorous defence of the old place. A number of well-directed buckets of water, plied rapidly when the fire showed itself, saved the old building. Unfortunately, no such action was taken at the orphanage and this splendid building was destroyed.

The successful resistance to the flames at the residence of James H. Moran, Esq. at Chipman's Hill prevented the spread of the fire to the northern portion of the city. The house was attacked by the fire from front and rear, but the efforts of a crew of workmen from the shipyard, aided by the city firemen, kept the flames at bay. The window sashes caught several times, and the men, finding neither timber nor axes, grasped the sashes with their naked hands and tore them away. This saved the building and stopped the spread of flames along Union St. and beyond it.

The fight with the flames on Reed's Point Wharf, which lasted from three o'clock in the afternoon until 4 o'clock the next morning was one of the most dramatic of the day. Between 1500 and 2000 people had taken refuge at the end of the wharf. A number of barrels containing kerosene oil or petroleum lay on the wharf. One man, a doctor, did much to save this situation even though the crowd would not help. The barrels were too heavy to roll into the water so he kept getting pails of water and throwing them on the barrels to prevent their explosion. He had all the women put on board a steamer at the end of the wharf and then together with a reluctant young man kept throwing pails of water on the fire. Finally, a passing tugboat came alongside and used its hose to deluge the wharf. In a few minutes the danger was averted.

LIFE AND PROPERTY LOSSES

Many people were burned or otherwise injured during this fire and 18 persons lost their lives. Twelve died from burns, two from injuries suffered when cornices fell, two from injuries inflicted by falling walls and two by drowning while attempting to save their property in boats. As a result of the loss of dwellings, approximately 2,700 families or 13,000 people were left homeless. Many commercial buildings, three theatres, thirteen churches, and a number of public buildings such as the Custom House, Savings Bank, Post Office, City Building and schools were destroyed. Fifteen vessels, mainly schooners, burned at their moorings.

Various estimates of the financial loss have been given. All estimates indicate that the loss was approximately $27,000,000. As far as can be ascertained, insurance losses were in the order of $6,500,000. A number of insurance companies were hard hit, particularly the mutual companies. The Maritime Mutual went

bankrupt. The Saint John Mutual paid scarcely anything. The Central of Fredericton, the Provincial of Toronto and the Stadacona met most of their obligations in time. Most insurance companies promptly adjusted losses. Unfortunately many of the dwellings were not insured. Adding to the number of persons left destitute were the householders who were insured by local mutual companies that went bankrupt. To lessen the impact of the loss, a relief fund was established (Appendix B). An estimated $250,000 was contributed in addition to huge quantities of supplies such as food, bedding and clothing.

COMPARISON WITH OTHER CANADIAN FIRES

A comparison of various features of the Saint John fire with the Toronto fire of 1904 and the Ottawa-Hull fire of 1900 reveal several differences and some similarities. Table II compares weather conditions at the time of all the fires. The one feature they have in common is a strong wind from the north or northwest. In each case it tended to channel the fire in one direction, which enabled some successful fire fighting efforts on the flank of the fires. All three fires were controlled only when the fire ran out of fuel. This was most noticeable in the Saint John fire where the fire destroyed everything in the peninsula-shaped area, stopping only at the water's edge. It is probable that in all three fires the wind caused an increase in the size of radiating flames on the leeward side of buildings, thereby increasing the exposure hazard. In the Saint John fire, as in the Ottawa-Hull fire, flying brands formed from burning wood shingles and other combustible materials and borne by the strong wind greatly influenced the fire spread.

Many types of building construction were involved in the three fires. All of the buildings had serious defects from the standpoint of conflagration hazard. In the Saint John fire and the Ottawa-Hull fire almost all buildings destroyed were wood frame houses with shingle roofs (Figure 14). In all three fires mercantile buildings were involved, although more so in the Toronto and Saint John fires. In Saint John and in Toronto, the average mercantile building was a four-storey brick structure with a somewhat small floor area. The floors were wood joist and there were open vertical shafts and windows front and back. Windows in the front ground floor were quite large. Industrial buildings involved in the Saint John and Ottawa-Hull fires were generally of wood joist construction, many of them entirely wood. There was no protection of vertical openings in the multi-storeyed buildings.

The contributing conditions for conflagration have been discussed in a companion report on the "Toronto Fire of 1904" (NRC 7830). In the Saint John fire all four conditions concerned with construction appeared to be present. The fire spread first in the congested mercantile area where the buildings were constructed in such a way that intense internal combustion was rapidly set up. In addition, there was a lack of firebreaks such as solid brick walls and window protection. On the other hand, the fire spread in the residential area was influenced by the contiguity of frame buildings and the prevalence of combustible roof coverings.

In the Saint John fire, unlike the Toronto and Ottawa-Hull fires, there is no record of interior sprinkler and standpipe systems nor of an exterior water curtain. The municipal water systems

at all three fires were severely taxed, but enough water was available to allow the firefighters to exert some control on the flanks of the fire. No information is available on the amount of water pumped at the Saint John fire.

The Saint John fire was fought by approximately 60 firemen and officers, including personnel from Portland and Carleton. Equipment used included six steam fire engines (two from outside) and several hose wagons. This is about the same number of men and pieces of equipment used at the Ottawa-Hull fire. At all three fires considerable assistance was rendered by hundreds of civilians. The chief value of fire fighting during conflagrations is to prevent flames from spreading across the wind and to extinguish brands that have alighted outside the zone of the fire. In general, the Toronto, Ottawa-Hull and Saint John fires bear this out. In all cases, 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 the flanks.

Summary Of Losses

Table III compares the losses incurred in all three fires. The Saint John fire, like the Ottawa-Hull, rendered a large number of people (13,000) homeless. To some extent the destruction caused by the Saint John fire was similar to that caused by the Toronto and Ottawa-Hull fires. For example, in the Saint John fire industries were destroyed as in the Ottawa-Hull fire. In addition, the heart of the mercantile area was destroyed as in the Toronto fire. Insurance coverage for the Saint John fire was low (22%) as was the case in the Ottawa-Hull fire, because of the large number of dwellings involved. As in the Ottawa-Hull fire, a relief fund was established and tons of supplies were contributed.

In the Saint John fire, which was under control in approximately nine hours, 200 acres were involved and approximately 2000 buildings and a number of ships and their cargoes were destroyed. Total value of vessels and cargoes lost was about $40,000. The loss at Saint John was felt to an even greater extent because of the number of public buildings, including 13 churches, which were destroyed.

Fire Loads Involved

Tables IV and V include a comparison of residential fire loads in Ottawa and Saint John and of mercantile fire loads in Toronto and Saint John. Table IV shows that fire loads and building density conditions in Ottawa and Saint John were similar. In the mercantile areas, the fire loads based on building areas were approximately the same for both Toronto and Saint John, whereas there was a significant difference between those based on fire areas because of the different building densities. The mercantile area in Saint John includes wharf warehouse facilities as well as normal business premises. One interesting note regarding the fire load in this area concerns the amount of flour involved. It is reported that 50 to 60,000 barrels were destroyed. This number of barrels would hold 9.8×10^6 lb of combustible material with roughly the same calorific value as wood. The calculations for fire loads make some allowance for the fire loads due to auxiliary combustible construction such as sheds, lean-tos, etc.

Spread Of Fire

The rate of fire spread has been estimated on the meagre information available. These rates are given in Tables IV and V. The rate of spread among residences in Ottawa was much greater than in Saint John in spite of the fact that the fire loads and building

densities were approximately the same. The rate of fire spread in mercantile areas was faster in Saint John than in Toronto even though the fire load and the building density were less. A possible explanation is that spatial separations between buildings when these separations are cluttered with wooden sheds have little value. Figure 15 is a view of the uptown area and shows a profusion of wooden sheds and fences. Sheds and fences behave in a manner similar to a conventional explosives fuse, transmitting fire from building to building. This same situation prevailed in the residential areas of Hull and Ottawa during the fire of 1900.

A comparison with model work has been attempted. Atallah (4) has compared the rate of spread during the Great Fire of London (1666) with the rate predicted from Thomas' expression

$$R_{\epsilon b} \cos \varphi = 0.0085 \text{ g cm}^{-2} \text{ sec}^{-1}$$

where ϵb is the bulk density of a wood crib (gm/cm^3), φ is the deflection of the flame from the vertical and R is the linear rate of burning. According to Atallah, a fuel bulk density of 0.43 gm/cc and an angle of inclination (φ) of 70° corresponding to a wind speed of 10 mph gives a value of 0.58 cm/sec for R. He estimates that the actual rate of spread was between 0.36 and 0.59 cm/sec.

For the residential areas of Ottawa and Saint John, the bulk density of the fuel was about 0.0051 gm/cc or about one ninth of the 1666 London value. The linear rate of burning was about 600 ft/hr or 5.08 cm/sec, which is about ten times the value. For the relationship to hold true, therefore, the angle of inclination of the flames must have the same value,

i. e. 70°, although the Ottawa and Saint John windspeeds were 25 to 30 mph, compared with the London value of 10 mph. An artist's impression of the fire suggests that the inclination was in fact about 70°.

On this subject Hamada (5) gives the relationship

$$\tan \theta = 4D/v^2$$

where

θ = inclination of flames to the horizontal (i. e. $\theta = (1 - \varphi)$)

D = flame depth

and

v = wind velocity (m/sec)

Substituting $\theta = 20°$ (or to be more precise 19. 1°) and v = 12 M/sec (=26. 6 mph) gives

D = 12. 45 metres = 43 ft which is a plausible value for the depth of the flame front.

CONCLUSION

This is the third large fire occurring in Canada that has been studied by the writer. Unlike large wartime fires, these conflagrations all originated from a single source of ignition. All occurred in the presence of a strong wind. In general, they spread in the direction that the wind was blowing and continued to spread until they ran out of fuel. The spread of the fire on the flanks was stopped some times by topographical features and at other times by relatively fire-resistive buildings coupled with determined fire-fighting operations.

In the report on the Toronto fire, the writer stated that "it is most improbable that similar conflagrations could occur today in these two urban centres under normal peace time conditions". It is the writer's opinion that the same statement could be applied to the Saint John fire.

ACKNOWLEDGEMENTS AND BIBLIOGRAPHY

The writer wishes to thank the staff of the Dominion Archives and the New Brunswick Museum for their help in securing and their generosity in lending photographs to illustrate this report.

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History of the City and County of St. John. Prize Essay on Saint John, 1783-1883, by D.R. Jack. Published by J. and A. McMillan Co., Saint John, N.B., 1883. In McGill University Library, Montreal.

Information was also obtained from the following newspapers:

Saint John Daily News. July 9, 1877.

Saint John Globe. July 12, 1877.

Saint John Telegraph. No date available.

TABLE I

OCCUPANCIES INVOLVED IN THE FIRE

Nature of Business	Number Destroyed	Nature of Business	Number Destroyed
Architects	4	Grocers (Wholesale)	40
Auctioneers	7	Grocers (Retail)	102
Bakers	11	Gasfitters and Plumbers	9
Banks	5	Hairdressers	13
Bankers, Private	4	Hardware Stores	8
Barristers	80	Hotels	14
Blacksmiths	10	Insurance Agents	29
Block and Pump Makers	8	Iron Merchants	8
Boarding Houses	55	Liquor Dealers (Wholesale)	27
Boat Builders	5	Liquor Dealers (Retail)	116
Bookbinders	5	Livery Stables	8
Book Stores	7	Lumber Merchants	12
Boot and Shoemakers	38	Manufacturers	20
Boot and Shoe Stores	14	Marble Works	6
Brass Founders	6	Merchant Tailors	36
Builders	27	Newspapers	7
Cabinetmakers	9	Painters	13
Clothiers	29	Photographers	6
Commission Merchants	93	Physicians and Surgeons	15
Confectioners	6	Printers (Job Work)	10
Dentists	9	Riggers	7
Druggists	8	Sailmakers	5
Dry Goods (Wholesale)	14	Ship Chandlers	14
Dry Goods (Retail)	22	Ship Smiths	8
Dining and Oyster Saloon	10	Stove Dealers	8
Flour Dealers	32	Tobacconists	7
Fruit Dealers	7	Undertakers	4
		Watchmakers and Jewellers	12

TABLE II

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, snowflurries, wind from northwest 25-30 mph.
St. John	20 June 1877	2:30 p.m.	75-80°F, sunny bright, wind from northwest 20-25 mph.

TABLE III

FIRE LOSSES

Fire	No. of Buildings Destroyed or Severely Damaged	Property Loss	Insurance	Life Loss
Ottawa-Hull	over 3200	$9,515,849	$3,855,595	7
Toronto	100	$10,350,000	$8,375,000	0
St. John	approx. 2000	$27,000,000	$6,000,000	18

TABLE IV

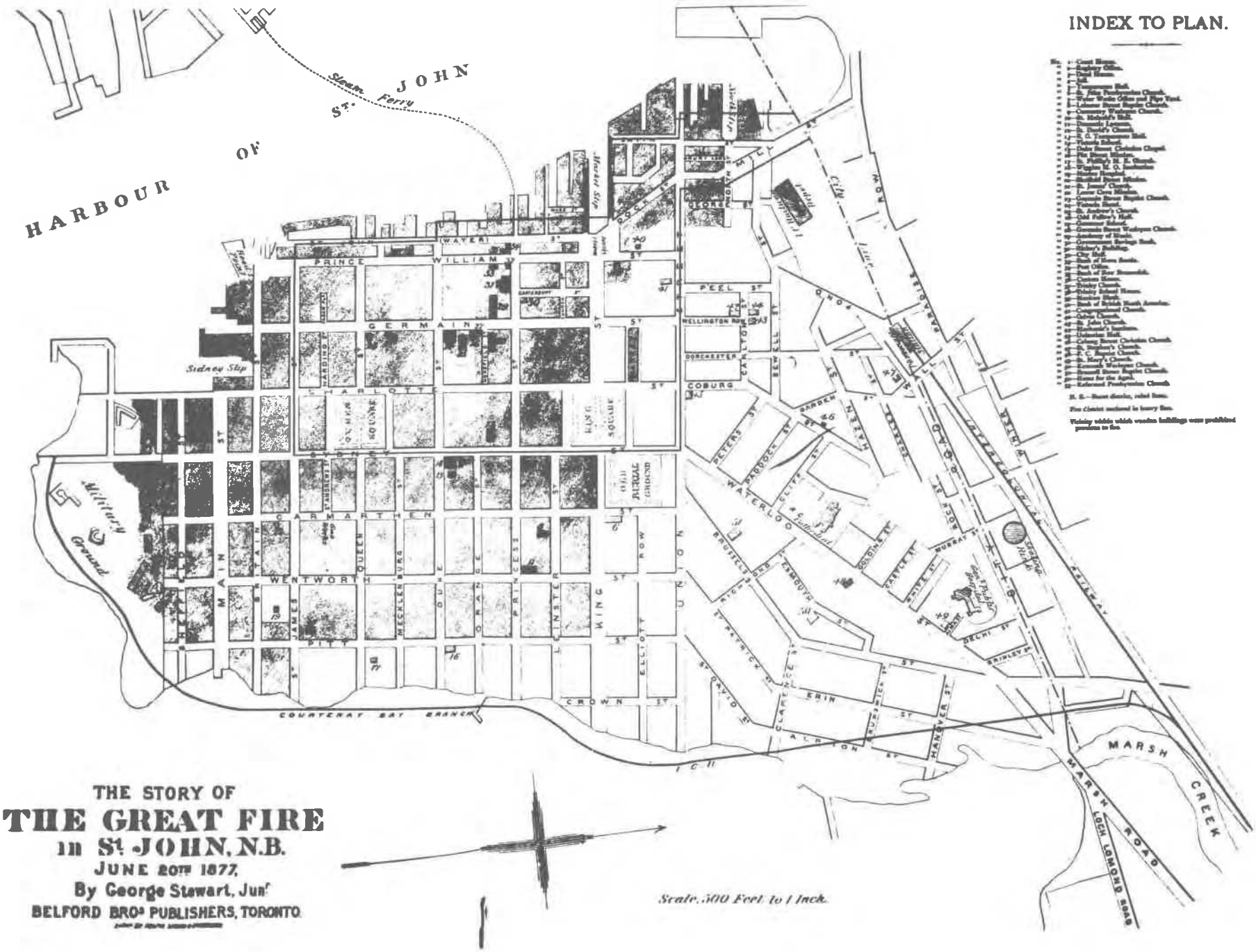
RESIDENTIAL FIRE LOADS AND FIRE SPREAD

City	Rate of Spread		Fire Load		Per Cent of Land Occupied by Bldgs.	Average Length of Fire Front
	Lineal (ft/hr)	Houses/1000 ft Frontage/hr	Per Unit Bldg. Area lb/Sq Ft	Per Unit Fire Area lb/Sq Ft		
Ottawa	800	140	64.1	7.8	12.2	1,950 ft
St. John	540	86	65.5	8.93	13.6	3,000 ft

TABLE V

MERCANTILE FIRE LOADS AND FIRE SPREAD

City	Rate of Lineal Spread (ft/hr)	Fire Load		Per Cent of Land Occupied by Bldgs.
		Per Unit Bldg. Area lb/Sq Ft	Per Unit Fire Area lb/Sq Ft	
Toronto	up to 185	125.5	74.5	59.4
St. John	up to 375	109.2	41.6	38.0



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THE STORY OF

THE GREAT FIRE

in St. JOHN, N.B.

JUNE 20th 1877.

By George Stewart, Jun'

BELFORD BROS PUBLISHERS, TORONTO

Figure 2 Market Slip, St. John, N. B. Early 1870's, South Market wharf in background (Photograph courtesy Early Photographs in Canada - Ralph Greenhill)

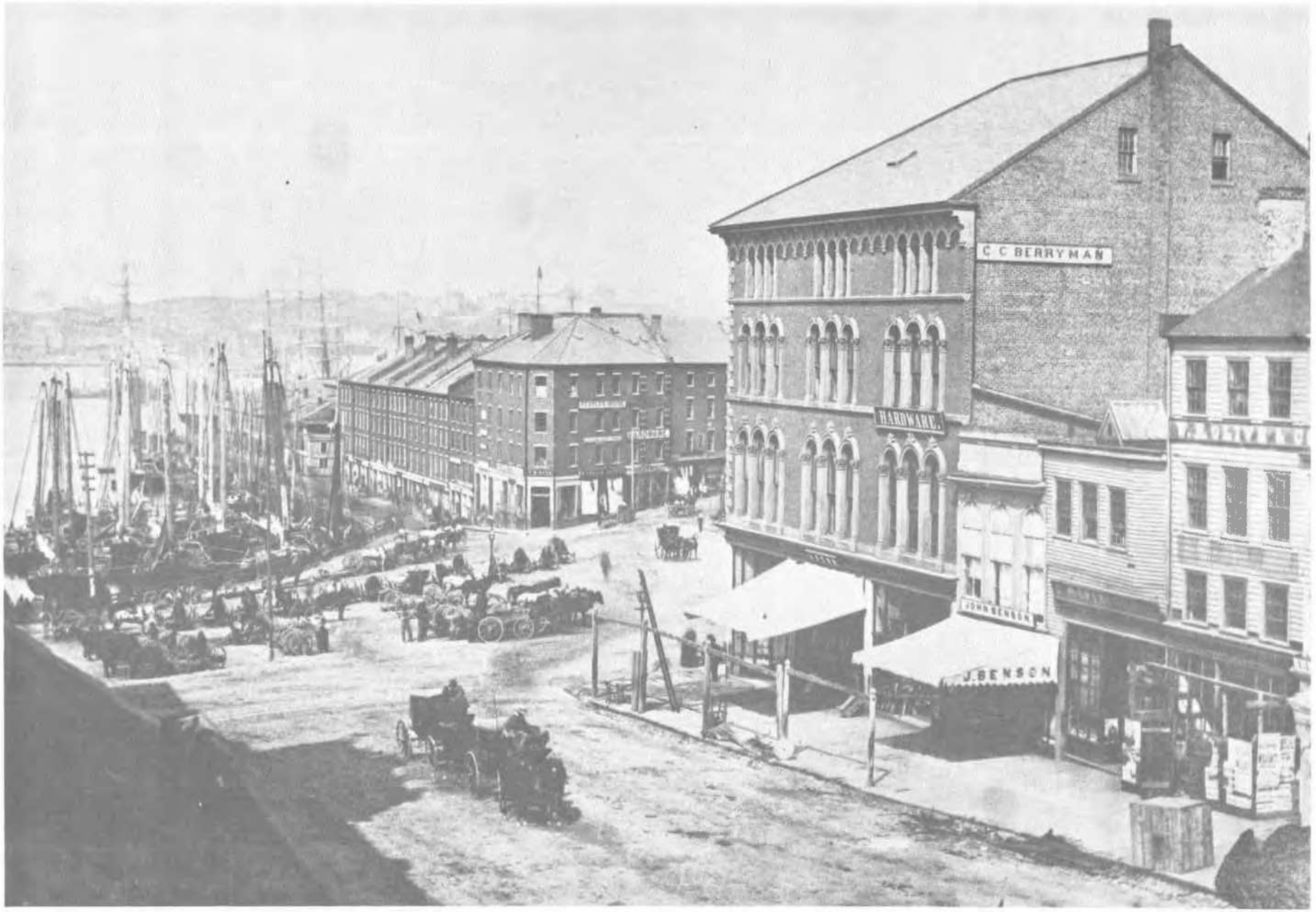

Figure 3 Lower King Street and Market Square 1864-70
(Photograph courtesy New Brunswick Museum)

Figure 4 Foot of King Street at Market Square, southeast corner
(Photograph courtesy New Brunswick Museum)

Figure 5 Prince William Street near intersection with King Street
Maritime Block in left foreground
(From "The Story of the Great Fire in St. John, N. B." by George Stewart)

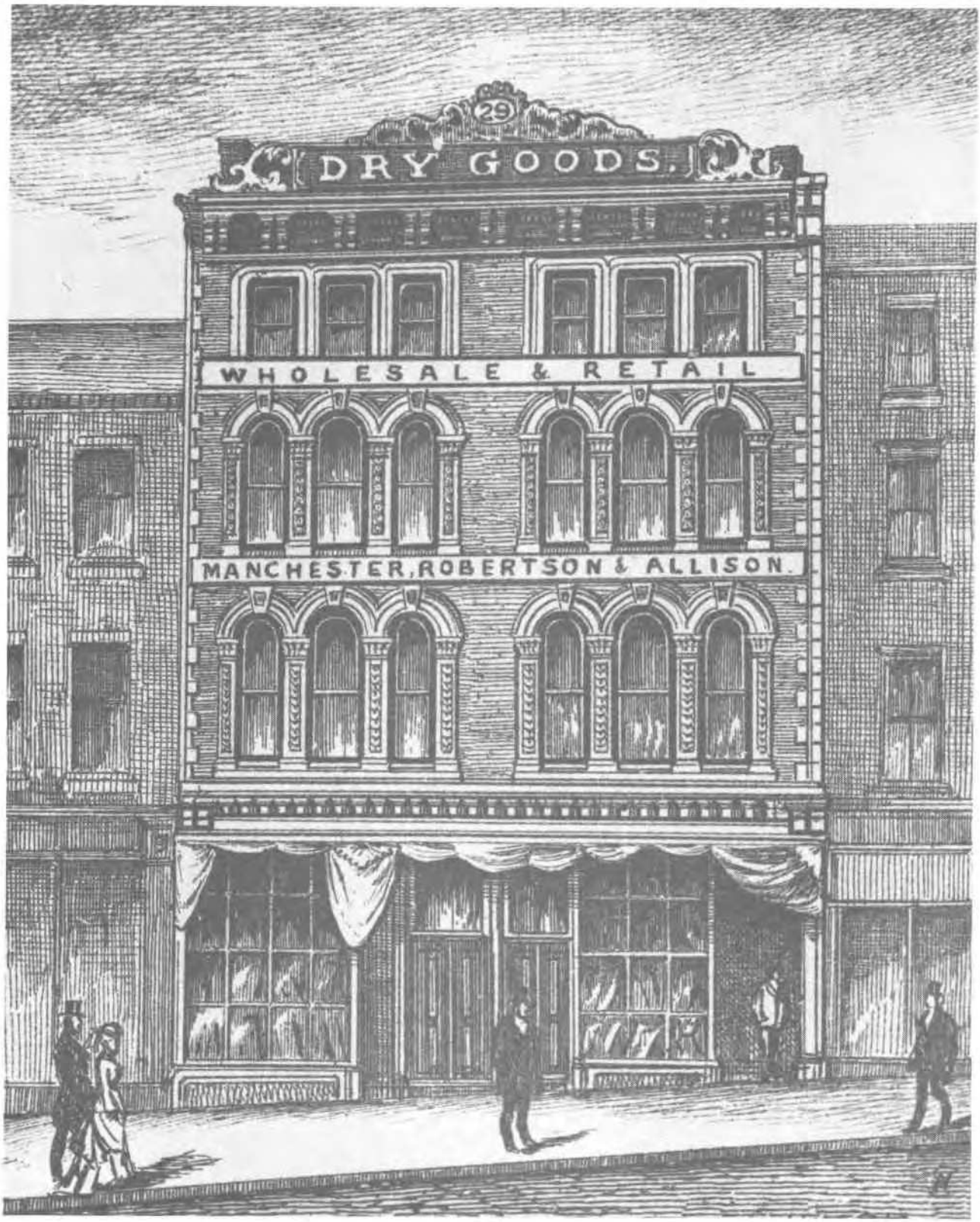

Figure 6 Building which prevented fire from spreading on north side of King Street (From "The Story of the Great Fire in St. John, N. B." by George Stewart)

Figure 7 North side of King Street. Bell Tower in background
(From "The Story of the Great Fire in St. John, N. B." by George Stewart)

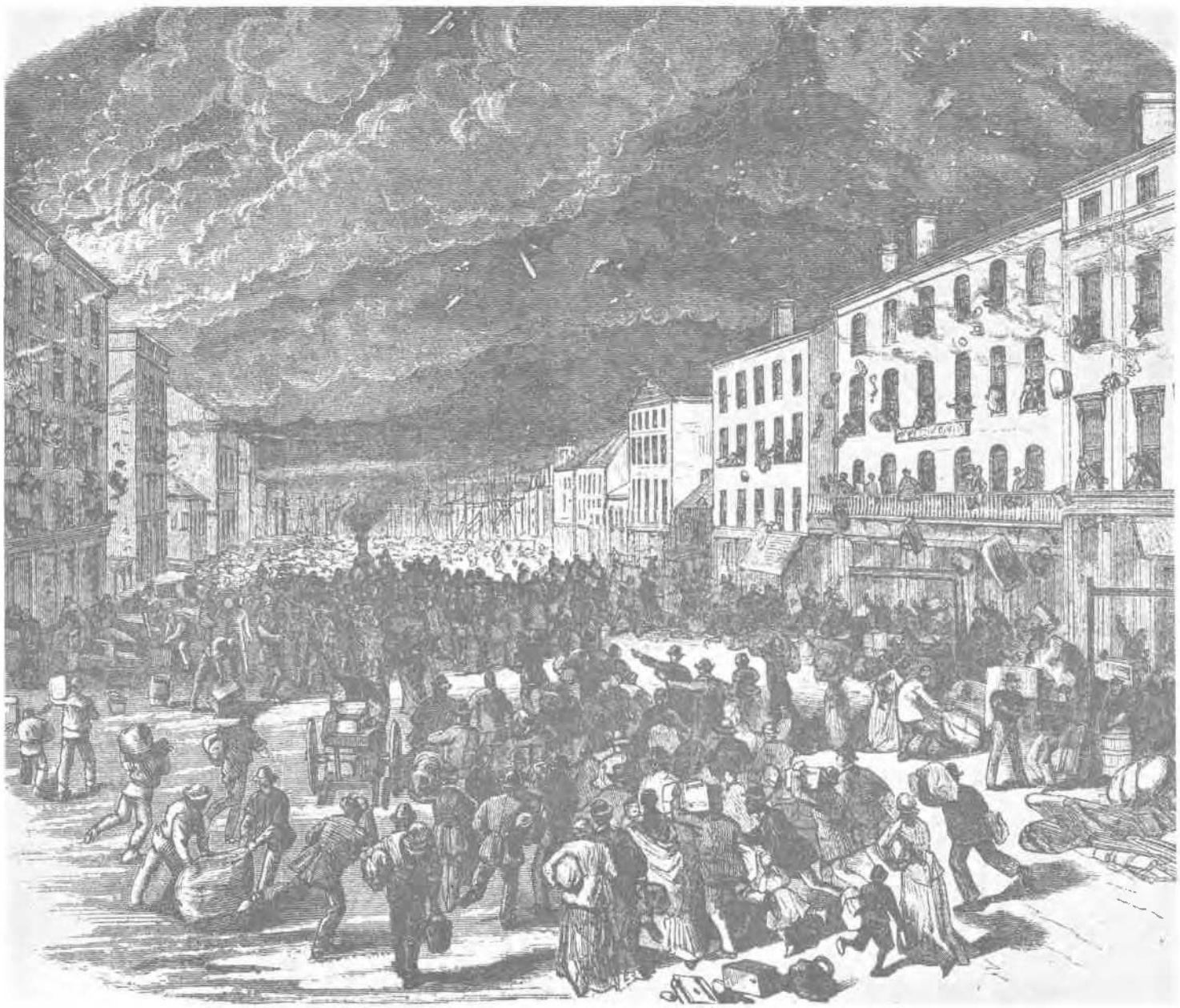

Figure 8 King Street looking west towards harbour
(Photograph courtesy Public Archives)

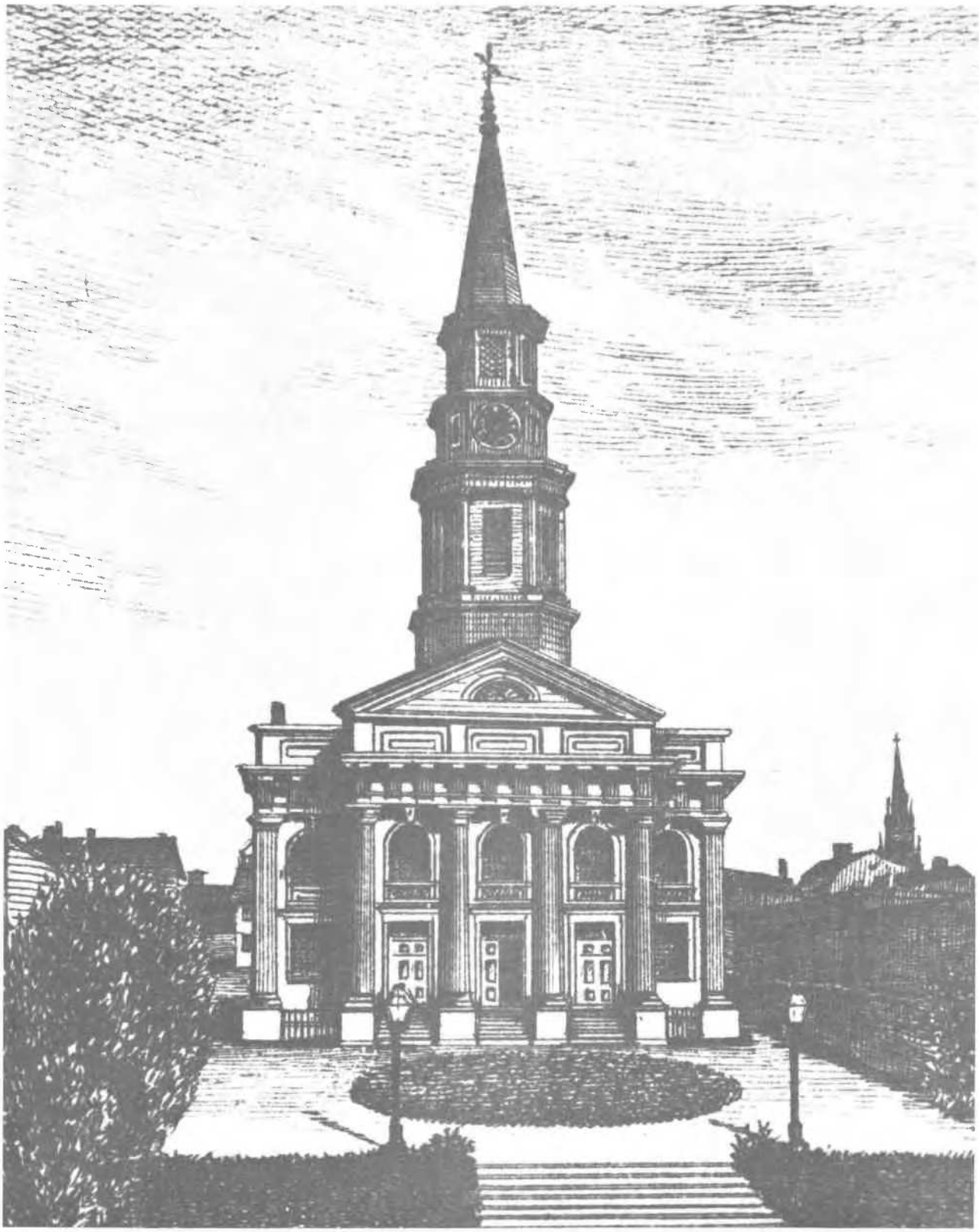

Figure 9 Trinity Church
(From "The Story of the Great Fire in St. John, N. B." by George Stewart)

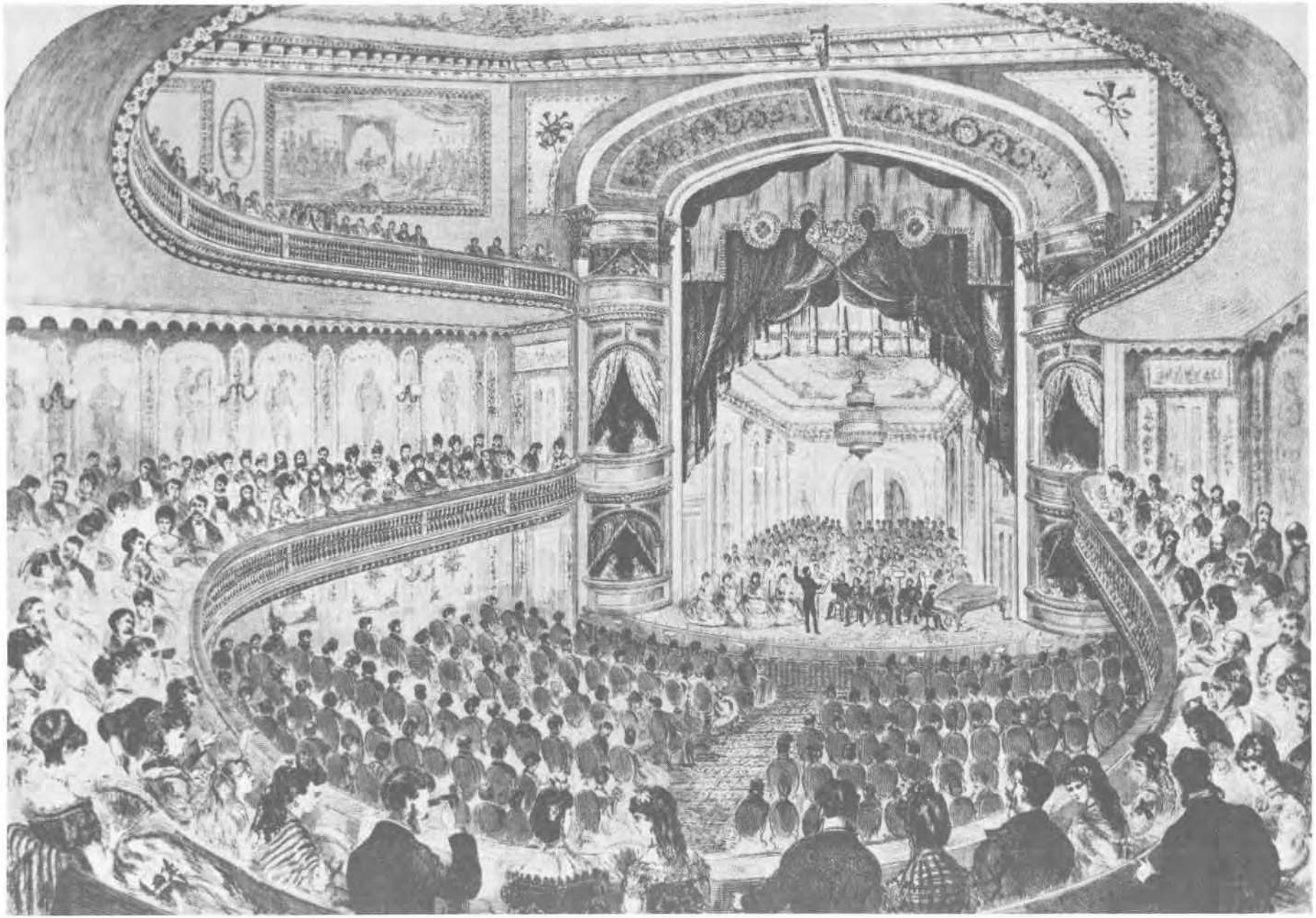

Figure 10 Opening of the Academy of Music, 1873
(Photograph courtesy New Brunswick Museum)

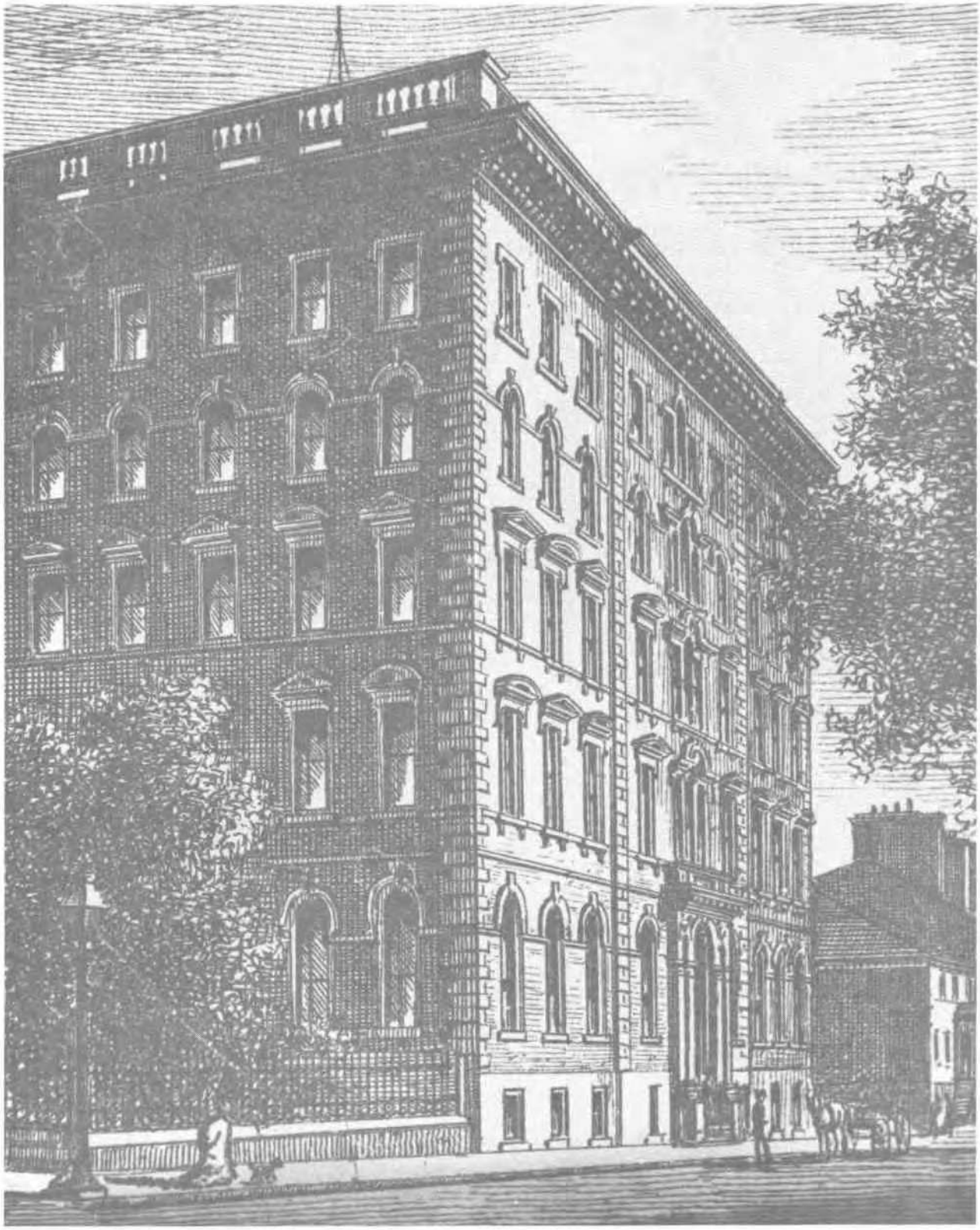

Figure 11 Victoria Hotel, corner Duke and Germain Streets
(From "The Story of the Great Fire in St. John, N.B." by George Stewart)

Figure 12 Residences facing Queen Square
(Photograph courtesy New Brunswick Museum)

Figure 13 New Post Office
(From "The Story of the Great Fire in St. John, N. B." by George Stewart)

Figure 14 Old Strange House (later Jonathan Sewell House) St. John, N. B.
(Photograph courtesy New Brunswick Museum)

Figure 15 View of St. John, looking towards Carleton
(Photograph courtesy Public Archives)

APPENDIX A

EARLY FIRE HISTORY

Saint John suffered many destructive fires prior to the conflagration that occurred on 20 June 1877. Over the years efforts had been made to improve the fire protection services of the city, including the water supply. The first serious fire recorded occurred on 18 June 1784 and destroyed 11 houses. On the same day seven houses were destroyed at the Falls and a woman and child were burnt to death. Two years later on 2 February 1786, the corporation purchased two fire engines for £136 6s 8d. These engines presumably proved ineffectual because in April 1787 a number of citizens lent the corporation £284 13s 4d to import two fire engines from London and to sink a number of public wells. In 1823 a fire began on Disbrow's Wharf that burned both sides of Prince William Street. During this fire over 40 houses were burned and the loss of property and goods was in the order of £20,000.

On 13 January 1837, a fire originated around 9:00 p.m. on Peter's Wharf causing a loss estimated at £250,000. This fire destroyed both sides of St. John or Water Street and Prince William Street between Cooper's Alley and Princess Street (Figure A-1). It also caused damage on Market Square, South Market Wharf, East and West side of Ward Street, the North and South sides of Peter's Wharf, Johnston's Wharf, Church Street and Princess Street. Over 100 commercial buildings and 115 houses were destroyed in this fire. During 1837 a water system was initiated whereby water was brought by a sluice from the tail of Gilbert's mill on Lily Lake to a cistern southwest of Marsh bridge. An engine and pump house was erected over

the cistern and a steam engine there pumped the water through a 10-in. main to a reservoir on Block House Hill. In the following year, a limited piping system for water in the city was installed.

In August 1839, a fire that started in Nelson Street burned the entire north wharf, both sides of Dock Street and Market Square. It did not cross Prince William Street. Property loss was estimated to be £200,000. In September of that year an Act for the better prevention of fires in Saint John was passed. In 1841 there were two serious fires. The first occurred on 26 August when a fire in suburban Portland destroyed 60 houses and caused £30,000 damage. On 19 November a fire broke out on the South Wharf and burned not only the wharf but Peter's Wharf, the south side of Water Street and the large brick Market House in Market Square. On 29 July a fire started in Water Street and destroyed 40 buildings.

In 1849 two more serious fires occurred. On 27 February a fire broke out in Lawrence's building on King Street, destroying a number of buildings among them the Commercial Hotel. It was during this fire that the tower of Trinity Church was pulled down in order that the church might be saved. In the following month another serious fire burned 100 houses. On 8 March 1877, a fire broke out in a building on Prince William Street owned by the Ennis and Gardner estate. This fire resulted in a loss of seven lives and a property loss of $2,000,000.

In 1850 a small dam was built at Scott's Mill on Little River and a 12-in. main $4\frac{1}{2}$ miles long was laid and connected to the 10-in. main installed in 1837-1838. In 1855 the city assumed responsibility for the water supply, and a number of changes were made in the system. The dam at the Little River reservoir

was built higher and stronger and a 24-in. main was laid from the reservoir beside the 12-in. main put down in 1850. These two mains were connected to an iron chamber from which water flowed into the original 10-in. main running up Brussels Street to the reservoir, a 12-in. main up Waterloo Street, a 12-in. main via the city road to Portland and some other mains. In the Little River Reservoir the water is 160 ft above high tide level and in the Leinster Street Reservoir, 132 ft. In 1868 a new 12-in. main was laid up Erin Street through St. Patrick and Wentworth Streets to Princess. The 12-in. main laid up Waterloo Street was extended along Sydney to Princess Streets and the Portland main was also extended. For the next nine years the system continued to be expanded at a rapid rate.

Figure A-1 Conflagration Jan. 14, 1837, Market Square looking south towards Prince William and Water Streets
(Photograph courtesy Saint John Fire Dept.)

APPENDIX B

RELIEF FUND

Immediately following the fire, large sums of money, and tons of supplies including foodstuffs, furniture and clothing began to arrive. The skating rink was set up as a refuge for over 300 homeless persons, and also as a provision storehouse. Relief was administered at first by a volunteer committee of citizens. Although this committee did a wonderful job, it soon became necessary to work through a proper organization. Consequently, the "St. John Relief and Aid Society" was founded. The Reverend S. Z. Earle was President and the Board of Directors was composed of the Mayor and a number of members who had the confidence of the citizens. Moneys were deposited in a bank and the rink was turned over to the Society as a headquarters for administering relief. The people who had been living in the rink were housed in tents on the barrack green. Great care was taken in disbursing relief to see that it was done in a fair and honest manner. This was a tremendous job as approximately $225,000 in cash and tons of supplies were disbursed. Another organized group who provided relief was the Society of Oddfellows. They had a fund of approximately $5000 in addition to supplies, which they distributed to needy brethren.