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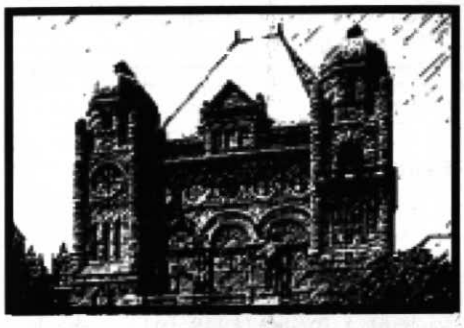

Geology of Parliament Buildings 3. Building Stones of Ontario's Provincial Parliament Building

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SUMMARY

Completed in 1893, Ontario's Parliament Buildings were designed to hold all the government and elected representatives' offices. Expansion of government services soon required the construction of several other buildings to house government offices. Using in its design mostly Canadian stone from Ontario and Quebec, the 1893 building was Toronto's first full Richardson Romanesque building. Partial reconstruction after a fire and the addition of a new wing combined to bring a variety of building stones to the site. A brief history of the building, and the properties of its stones – their strengths and weaknesses, is presented along with the result of a century of exposure to the city's weather, and the maintenance schedule underway to ensure another century of use.

Sommaire

Terminé en 1893, les édifices du parlement de l'Ontario avaient été conçus pour concentrer les bureaux de tous les députés. Par la suite, la multiplication des services gouvernementaux a nécessité la construction de plusieurs autres édifices pour héberger les bureaux gouvernementaux. Utilisant principalement des roches de l'Ontario et du Québec dans sa conception, les édifices de 1893 furent les premières constructions de Toronto du pur style romanesque Richardson. La reconstruction partielle après un incendie et l'adjonction d'une aile explique la variété des pierres de taille du site. Le présent article décrit brièvement l'histoire de l'édifice ainsi que les propriétés des pierres (leurs points forts et leurs points faibles étant analysés dans le contexte d'un siècle d'exposition aux intempéries de la ville), de même le programme d'entretien en cours visant à prolonger leur vie utile d'un autre siècle.

BACKGROUND

It is stated that the three most important factors in choosing a place for a home are location, location, and location. So it was in 1787, when Sir Guy Carleton, governor-in-chief of Canada, arranged for a treaty to acquire 250,880 acres (101,530 hectares) encompassing one end of a long-used portage route to the upper Great Lakes. A few years later the Constitutional Act of 1791 created Upper Canada with its English laws, and Colonel John Graves Simcoe was appointed Lieutenant-Governor. Simcoe wanted a suitably defensible site for the capital city of Upper Canada, and in the spring of 1793 the best harbour on Lake Ontario at the end of the portage route to the upper Great Lakes became the chosen site.

Subsequently a series of Parliament Buildings were occupied in the city. Two were destroyed by fire, then the union of Upper and Lower Canada in 1841 caused the capital to be located both outside and sporadically within the City. Finally, with confederation in 1867, Ontario's capital was returned to its old site, and its old building, in Toronto.

Kivas Tully (1820-1905), provincial architect, first proposed a new government building in 1873, and on January 4, 1880, perhaps encouraged by a letter received from the Queen's Printer in November 1879, he again outlined the condition of the existing parliament buildings. The letter, written by J. Notman (Archives of Ontario, RG-15-18-1, box 26) stated: "Let me advise you to step up to the quarters of the Queen's Printer and see the wretched condition of the floor. If you can lay on the outer office floor, something similar to that laid in the Post Office and Hall, I will be satisfied. If not, I will have to put a notice on the outer door "Beware of Man-traps and Spring-guns" so that comers may guard against danger."

After commenting, "for fuel, gas and water the average annual expenditure is about $2000. It requires 172 tons of anthracite and 135 tons of bituminus coal, also 75 cords of hard and 15 cords of pine wood to heat the buildings: 55 stoves and 45 open grates being in use. ... I now unhesitatingly say that the present buildings [completed in 1832] are totally unsuited to the requirements of the Province, and cannot be altered to meet the accommodation that is now urgently needed. It is, therefore, a matter of serious and unavoidable consideration whether the present buildings and site should not be abandoned, and new buildings erected elsewhere." (Government of Ontario, 1880).

Although not stated, the implication was that central heating would finally be possible.

On February 18, 1880, the Province obtained a site (Fig. 1) for new Legislative buildings on land that had been leased by the City from the University of Toronto in 1859 on a 999-year lease and a promise for a portion to be used for the provincial parliament. This leased land was dedicated as Queen's Park by the Prince of Wales in 1860. Tully wrote the Commissioner of Public Works in February 1880 outlining the site, general arrangement, and style of buildings suitable for new Legislative buildings. He approved of the site's geology. "The elevated position there on the first sand ridge north of the bay, affords every facility for efficient drainage, with a firm substratum of clay on which the foundations would be built." (GO, 1880). The sand was deposited during a low-level stage in the history of Glacial Lake Iroquois and forms a broad ridge named Clover Hill at the site of St. Basil's College a block away to the northeast. The clay is part of a varved glaciolacustrine sequence that was well known to early residents of the city from its exposure in the "Blue Hill" created where Castle Frank Creek crossed Yonge Street – a sticky and difficult traverse in wet weather.

Tully then proposed buildings "designed in the Early English or Pointed architecture of the thirteenth century... This style, or as it is commonly but erroneously termed Gothic, was fully proved ... to afford greater area for light, equal facilities for ventilation, and to present a more chaste and elegant external and internal effect at the same cost, than that of any other style." (GO, 1880). To obtain a building of note, the Commissioner of Public Works announced an international competition on April 26, 1880 "for the Provincial Parliament and Departmental Building or Buildings, proposed to be erected in the Queen's Park, in the City of Toronto" (AO, RG 15-61a).

The specifications to architects issued the following day included the following:

> From recent examinations on the site by means of trial pits, it is believed that a firm and reliable foundation can be reached at a depth not exceeding eight feet from the surface of the ground. Stone suitable for coursed rubble work and flagging can be procured in Ontario from the Milton, Georgetown, Guelph or Caledon quarries on the lines of the Hamilton and Northwestern, Grand Trunk and Credit Valley Railways, and for finer work from the Shelbourne quarries on the Toronto, Grey and Bruce Railway. Red and white bricks are procurable at Toronto, and moulded bricks at Ottawa, Peterborough and Belleville. (GO, 1887).

BUILDING DESIGN

A jury consisting of Alex Mackenzie, the federal Commissioner of Public Works, William George Storm, a venerable Toronto architect, and Richard A. Waite (1848-1911), who had recently designed two major office buildings in Toronto, reluctantly placed designs by Gordon and Helliwell first, F.X. Berlinquet second, and David Ewart third out of 16 submissions, based primarily on cost. Their report states, "We cannot recommend the adoption of any one of the three designs, as each is in plan and elevation, unworthy of the site." (AO, RG 15-18-1a). The design of Darling and Curry was preferred, but rejected as it was significantly over budget. As all these designs of October 1880 estimated a price greater than the $500,000 allotted for building, the Department of Public Works on February 25, 1881 asked six of the contestants to submit modified plans. From these submissions, the plans of Gordon and Helliwell, and Darling and Curry were chosen, and they were requested to prepare drawings and specifications for tender in January 1882. The lowest quotes returned were respectively, $542,000 and $612,000 (GO, 1887a). Darling and Curry's gothic design reminiscent of the Centre Block of the Federal Parliament Building was published in *From Front Street to Queen's Park* (Arthur, 1979, p. 54). Another competitor's drawing in a similar style is reproduced as Figure 2.

Richard Waite reviewed the plans for the government and in October 1885 pronounced both Gordon and Helliwell's and Darling and Curry's submissions 'unsuitable and defective'. The government then raised the allocation for construction to $750,000.

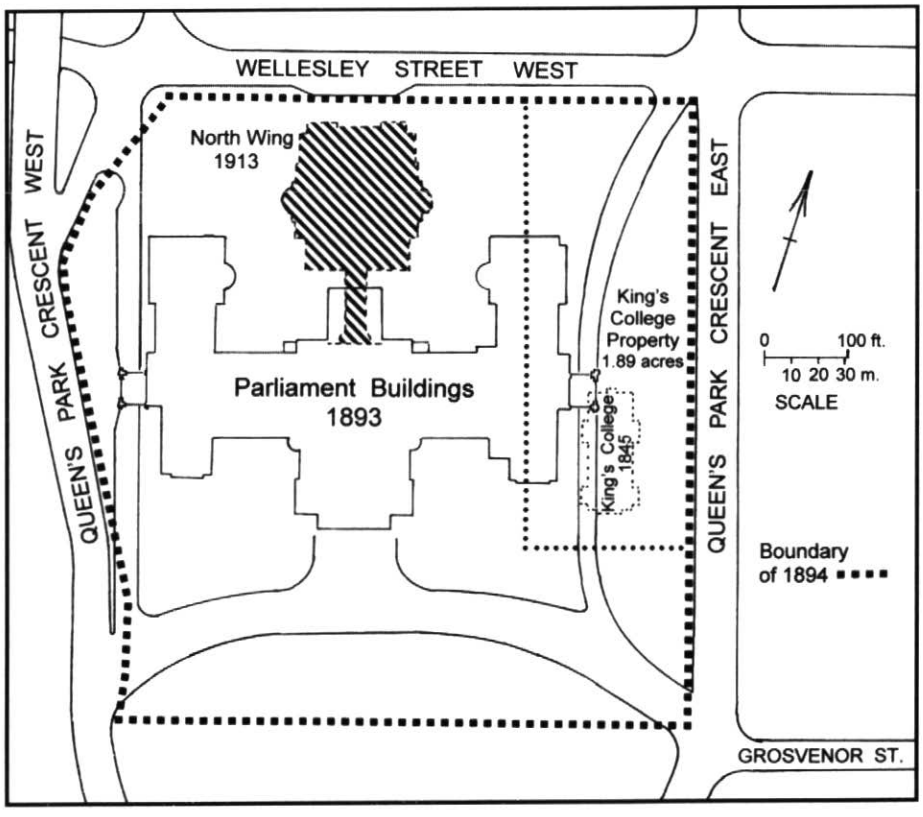

Figure 1 The 9.36 acre site (within the bold outline) of the Ontario Parliament Buildings.

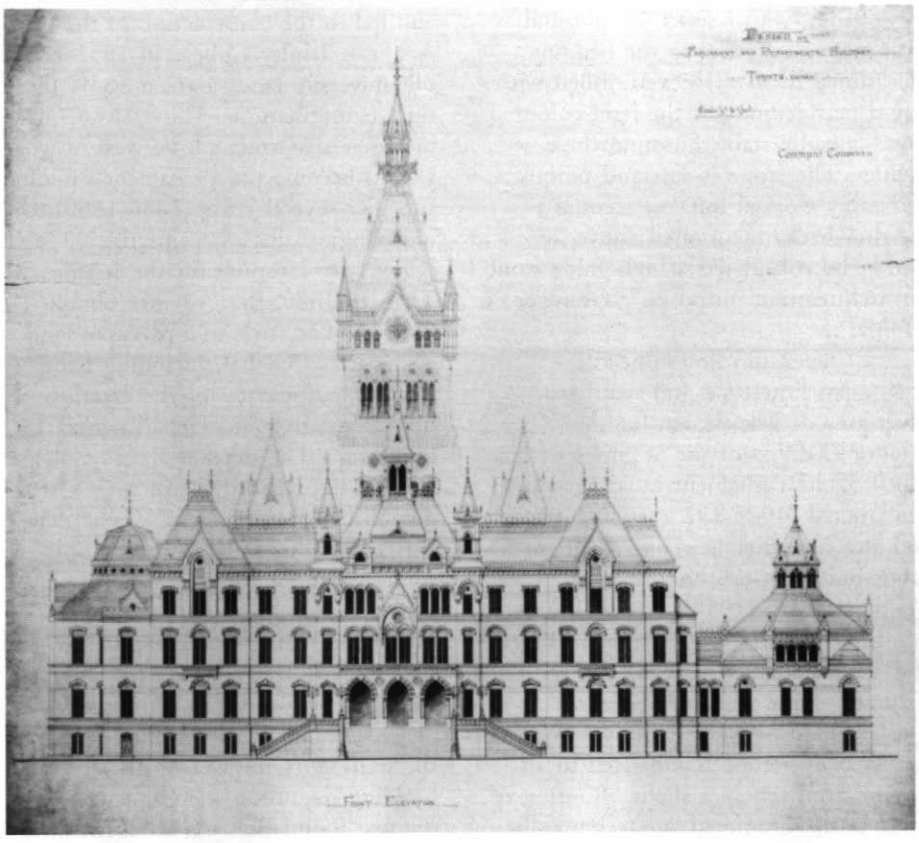

Figure 2 Proposed front elevation for Ontario Parliament Buildings submitted by Augustus Laver of San Francisco to meet Kivas Tully's "pointed architecture" criteria. (Archives of Ontario, RG 15-13-2-164, AO 5933)

Next C.F. Fraser, Minister of Public Works, asked Waite to submit plans and an estimate for the building. Waite did, and was offered the contract, which he accepted on January 8, 1886 (Gardiner, 1985). The government then announced on March 23, 1886 that Waite had been selected to build the new Provincial Parliament and Departmental buildings that ultimately would cost, with furnishings, $1,372,994.50 (Arthur, 1979).

Waite chose the Romanesque style popularized by the architect H.H. Richardson to accommodate the plan recommended by the provincial architect, Kivas Tully (Fig. 2). Henry Hobson Richardson (1838-1886) popularized the rounded vaults of Roman architecture to such a degree that the term Romanesque is applied to nearly all his major buildings. The style is of simple silhouettes, horizontal lines, and broad roof planes. The main entrance is usually within a broad semi-circular arched entryway. He also helped pioneer modern styles by emphasizing function within the building. The "rock-faced exterior finish is highlighted with an occasional enrichment of foliated forms on capitals or belt course. The façade is punctuated with transomed windows set deeply into the wall and arranged in groups in a ribbon-like fashion. Towers are short and chimneys are usually squat so as not to distract from the solid shape of the building." (Blumenson, 1981).

Waite's plan called for a central building with east and west wings accessed from roadways on the east and west sides of the Park. The design occupied an overall width of 490 feet (149 m) and a depth of 230 feet (70 m) with the central block projecting 70 feet (21 m) forward of the wings. By March of 1886, with his drawings well advanced, Waite wrote to Minister Fraser: "The building is divided into well defined blocks, these being arranged on the site in the best manner to obtain light and artistic grouping externally. The great hall occupying a central position in the front, a distinctive and integral part of the design prominently pronounced externally; its axis arranged at right angles, or parallel to the blocks of offices, and united to them, not in a parsimonious, niggardly, manner, but with an obvious desire to produce an impressive effect upon the visitor, and to make a good approach without apparent effort. There is no long struggling corridors bent or twisted to connect two parts or offices." (GO, 1887b)

Eric Arthur described the contrast between Waite's Romanesque design and Tully's Early English pointed architecture vision as: "No greater contrast in scale could be found than the rugged masonry of the Parliament Buildings and the sharp Victorian Gothic ... design of 1880, in which stone piers were narrow and vertical with glass filling the interstices. Those were the kind of structures with a hallowed tradition of soaring rather than standing four square on the ground." (Arthur, 1979, and see Fig. 2). Arthur approved of Richardson's architecture that "stood out like rocks in the urban sea of insincere and trivial building that characterized his period. In Toronto nothing for a mile around comes close to the scale of the City Hall, which is a good example of the Richardson manner; and the legislative buildings in Queen's Park, ... reduces almost to insignificance its loftier, younger neighbours." (Arthur, 1964). Not everyone approved of Waite's design as is shown by the following statement, likely from a sore loser in the competition: "The design of this building is so wretchedly bad in the composition that no possible beauty of detail or profuseness of carving can redeem it, granting that the mind which could design such a weak and inartistic composition would be able to give us good work in individual parts, and in the detail." (Canadian Architect & Builder, 1888).

Waite had worked steadily from his January 1886 appointment to prepare drawings for tender. On October 7th, the 26 tenders for construction were examined. As the type of stone to be used had not been specified, the tenders listed several sources (Table 1). These included Pelee

Island stone, Ohio Buff sandstone, Credit Valley stone, and Queenston limestone. Some idea of the quality of these stones may be gathered from the prices quoted for their use by the Toronto Stone Co's tender: Credit Valley, $1,018,317; Queenston, $929,252; Ohio stone, $837,212; and Pelee Island stone, $802,993 (GO, 1887a).

The choice of the very durable, and harder to carve, Credit Valley sandstone was probably urged by Waite as the most suitable stone for his design that incorporated 1870s and 1880s designs by the architect, H.H. Richardson. Richardson worked many of his buildings in "brownstone", a builder's term for reddish-brown sandstone. Once chosen, the tender prices were reviewed and the tender of Lionel Yorke, who obtained a reduced price for Credit Valley stone from the Chisholm quarry and a change in brickwork, was chosen on the basis of $671,250 for Credit Valley stone and $81,000 for 13.5-million bricks from the brickyard of the Central Prison (GO, 1887a). See Appendix for details of Yorke's revised tender.

The choice of the Credit Valley sandstone was wise. The limestone weathers more rapidly than the Credit Valley, and while Ohio sandstone is easier to carve it is more prone than Credit Valley to react with atmospheric pollution (see fig. 16 in Lawrence, 2001). In referring to the Pelee Island stone, Goudge described it as a magnesian limestone belonging to the Middle Devonian Onondaga [Dundee] Formation and stated "the great part of the stone exposed is of dull, brownish grey shades, with streaks of light and dark material parallel to the bedding. Occasional fossil cavities are filled with liquid petroleum, and the light-coloured stone is badly stained around these cavities. The stone is soft and porous and easily worked but, on account of the drawbacks mentioned above, it cannot be considered a high-grade stone for architectural purposes." (Goudge, 1933).

Queenston limestone is a magnesian limestone and weathers silver-grey. It was chosen for the exterior cladding of the Whitney or East Block of the Parliament buildings when constructed (1925-1927; 1930-1933), and also for other newer government office buildings nearby, the Frost Building North (1954), Frost Building South (1966) and the Macdonald Block and associated towers (1967-1971). It is a durable stone when placed and finished to shed water rapidly. "In cities ... where the stone is subjected to an impure atmosphere a slight blistering of some bush-hammered surfaces may be observed.... The stone is liable to a slow and slight differential weathering in acid atmospheres, but its stability and soundness is not affected, ... The fine-grained dolomitic matrix is the first to be affected, it is etched away and the calcite fossils left in relief." (Goudge, 1933).

THE SITE

As mentioned, the site (Fig. 1) is on former University of Toronto lands, where in 1842 construction began on the Anglican King's College. Demand by non-Anglicans resulted in the college becoming non-denominational in 1850 and led to the construction of the Anglican Trinity College in 1851-1852 off university lands and, in 1859, the non-denominational University College on university lands a little west of what was to become the Parliament Buildings site. For several years (1856-1860), the old King's College became the 'University Hospital for the Insane'. Then in 1880, the Province obtained from the City title to a parcel of land (9.36 acres; 3.8 ha), including King's College, sufficient "for the erection of new Legislative and Departmental buildings". The derelict King's College was left until 1886 when it was demolished to make way for the new Parliament Buildings, and to supply some bricks for use in the new construction. To complete their ownership of the site, the province paid $30,000 to the University for King's College's 1.89 acre plot in 1888.

A solid masonry building where the walls carry the weight of the building requires a solid and well-drained foundation. As Kivas Tully, the Provincial Architect and Engineer, stated the site lay "on the first sand ridge north of the bay" – a deposit from a low level stage of the 12,000 yr. B.P. Glacial Lake Iroquois. This was part of what early citizens of the city called the 'Sandhill', "a moderate rise, showing where, in by-gone ages, the lake began to shoal. Building requirements have at the present day occasioned the almost complete obliteration of the Sandhill. Innumerable loads of the loose silex of which it was composed have been removed. ... The residue of the Sandhill rise that is still to be discerned westward of Yonge Street has its

Table 1 Properties of the stones chosen and considered for use in the Ontario Parliament Buildings.

Stone	Absorption %	Pore space %	Bulk specific gravity	Weight lbs. / ft.^{3}	Crushing strength psi
Credit Valley ss	2.86	13	2.34	146	14905
Portland ss	± 4.3		2.35	146.7	12580
Sackville ss	5.94	13.9	2.33	145.7	11899
River John ss	5.54	12.9	2.34	146	15147
Red St. Bees ss	6	19-22	2.15	134.6	12031
Red Lazonby ss	2.4	11.5	2.33	145.8	13444
Ohio buff ss	5.8		2.4	134.3	8014
Queenston lst	2.67	6.92	2.79	162	14395
Pelee Island lst	4.54	10.98	2.42	151	8090
Longford lst	0.13	0.37	2.7	168.5	22968

winsome name, Clover Hill." (Scadding, 1873). Construction of the University Subway line underneath the Parliament Buildings in 1959 revealed that the chosen site consisted of 3 to 4 m of Lake Iroquois sand overlying some 13 or 14 m of varved clay (Lajtai, 1969).

The clay belongs to the Bloor Member of the lower Thorncliffe Formation, and extends from the Don Valley Brick Works westward beneath the Royal Ontario Museum and underneath Queen's Park (Karrow, 1967; Sharpe, 1980). This glaciolacustrine clay was deposited during a period of ice withdrawal, called the Port Talbot Phase of the Elgin Subepisode some 43,000-48,000 yr. B.P. (Karrow et al., 2000).

CONSTRUCTION

Waite issued Specification 1 in July of 1886 for the excavating, stone masonry, and bricklayers' works. Waite had specified Portland Arkose from Connecticut for some of his earlier buildings (Canada Life Assurance Co., pre 1883, Hamilton, ON) and he specified some large stone blocks for the Parliament Buildings such as he had been able to obtain. This requirement created difficulty later when blocks of the size specified could not be obtained from the Credit Valley quarries. Lionel Yorke won the contract, which he signed on October 7, 1886 and began on October 11th to excavate and pull down the King's College building to meet a completion date of November 5, 1889. In the spring of 1887 excavation was slowed when the old sewer drain from King's College emptying into the University's Taddle Creek was found to run across the site. In April 1888, Yorke won the contract for Specification 2 – for the carpentry, joiner and other works in erecting the "carcase" of the new Parliament Building – this referred to major wooden structural elements and roofing.

The request for tender to Specification 1 details the cut stone use above and between the large dimension stones. "All stone must be cut to lie on its 'natural bed,' .... The facing for body of walls ... to be 'irregular-coursed random, snecked, or square ashlar work,' rock face. The rock-facing to be pitched from, and not project less than one and one-half (1½) inches from line of joint, and vary to four (4) inch projection; and, however rough, to project in the centre and possess four well-defined edges. No stone of less area than forty-two (42) square inches on the face to be used and no stone to have a bearing area on bed less than the area of its face." Joints were specified at ¼ inch. (AO, 1886). Judging from the plans submitted and signed off by Lionel York, Waite appears to have allowed the contractor and stonemasons a large measure of artistic license for the carved details (Fig. 3).

The annual reports of the Minister of Public Works outlined the progress of construction. "The works in conjunction with the erection of these buildings were resumed early in the season, ... and the walls of the basement have been built to the ground floor line, with the exception of the plinth course on the outside walls of the building." (DPW, 1887). The following year it was reported that, "Considerable progress has been made in the erection of the ground floor portion of these buildings. This portion of the mason work of the new buildings, owing to the large size of the dimension stone requisite, has been necessarily more difficult and slow of execution than will, as I confidently expect, be the remainder of the work." (DPW, 1888, and see Fig. 4 and 5). "The ground floor portion and nearly the whole of the second story were completed this year. Some delay was caused by the death of the contractor for the masonry, etc., Lionel Yorke, ... An agreement was made with Messers. Carroll, Gaylord and Vick for the completion of the late Mr. Yorke's contract." (DPW, 1889). And finally, "Considerable progress was made in the construction of these buildings during the year. The roofs were completed and the buildings protected from the weather, with the exception of the slating in the central portion, the slates for which are now on the ground and the work in progress. The plastering of the east and west wings and the intermediate portions is now nearly completed. The works connected with the steam heating, ventilation and plumbing, and the interior wood finishing are well advanced, and progress has been made in the construction of the outer drainage. The cut-stone work, masonry, and brickwork is completed with the exception of the main entrance, and 'porte cocheres', which will be completed early next year." (DPW, 1891). The year 1892 saw all of the cut-stone work completed with the exception of some outside carving. The building was complete enough that the Department of Public Works moved into their quarters on the 4th of August, followed by the Treasury Department, and the Provincial Secretary and Attorney-General's departments before year end. The Department of Crown Lands moved in in January 1893, and the formal opening of the Parliament Building took place on April 4, 1893.

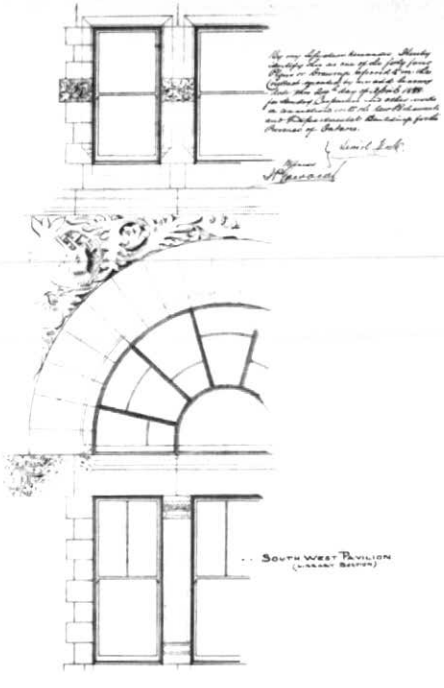

Figure 3 Part of Waite's exterior elevation for the Parliament Building showing the style and concept of stonework to be performed (Archives of Ontario, RG15-13-2-130, Sheet 11-1-G-12).

WHENCE THE STONE

Lionel Yorke's tender specified rubble masonry for walls below ground (see appendix). Excavation for basement ramp access in the 1990s revealed the basement walls to be neatly constructed, in coursed ashlar, of a hard

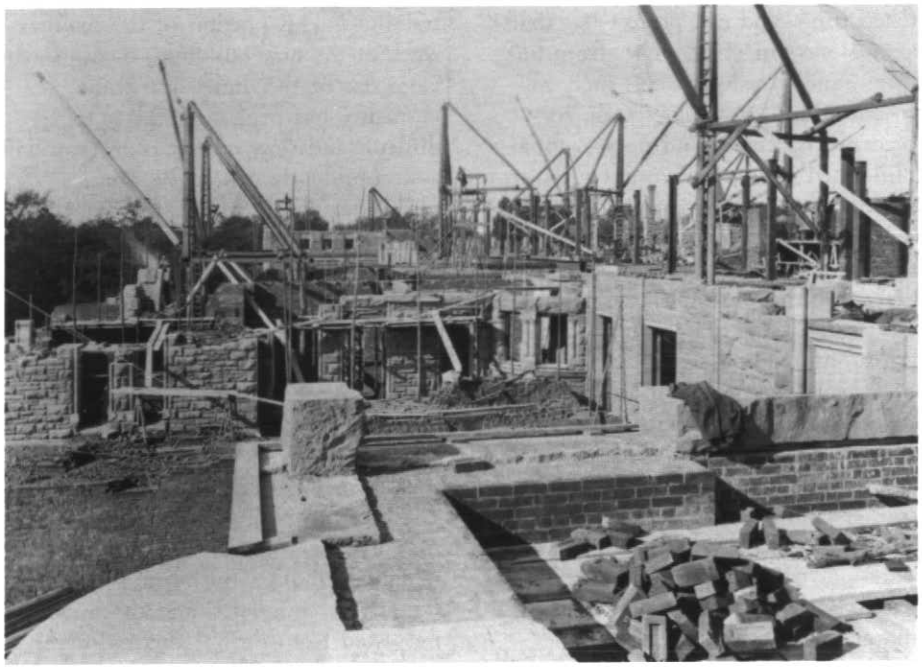

Figure 4 View west from the east or Departmental Wing across the Great Hall with the Member's Wing and library in the distance. (Archives of Ontario, RG 15-74-0-1.1, AO 5968)

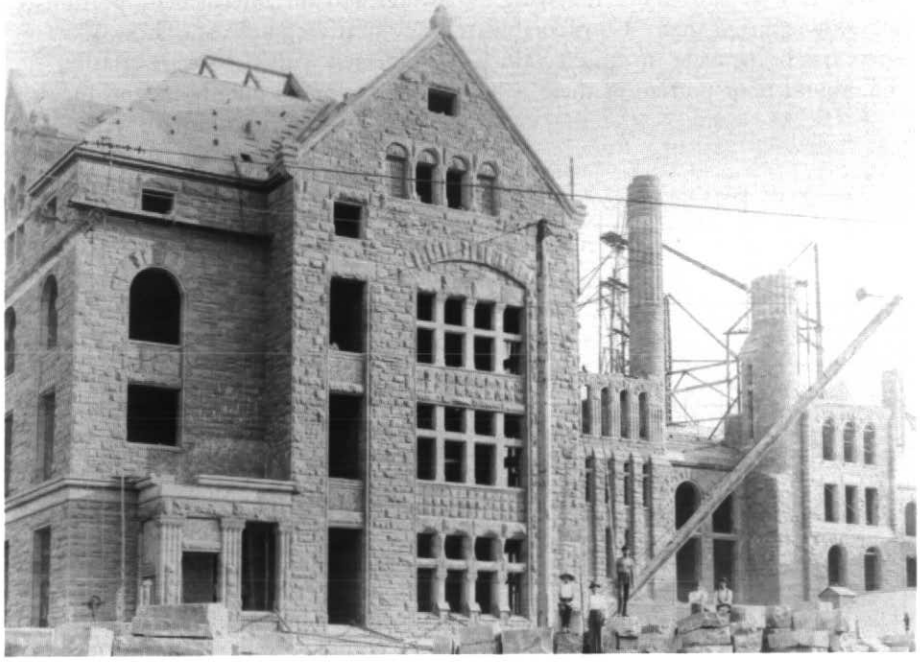

Figure 5 A later view looking southwest with the Departmental Wing in the foreground. Note the large blocks of stone in the building and on site. The larger stones in the foreground are about 60 cm thick. (Archives of Ontario, RG 15-74-0-1.2, AO 2094).

subconchoidal-fracturing white limestone with stylolites and small crystals of calcite. This is the stone known as "Longford", a white-weathering, brittle, high-calcium limestone from near Longford, on the east side of Lake Couchiching (Miller, 1904; Parks, 1912; Goudge, 1933; Hewitt, 1964).

The exterior of the original building specified Credit Valley stone, named for the quarries along the valley walls of the Credit River northwest of Toronto (Fig. 6). It was extracted from the approximately 438-million year old Whirlpool Formation of the Medina (Cataract) Group of Lower Silurian (early Llandovery) age. The Whirlpool Formation is a very fine- to fine-grained subarkose to quartz arenite sheet-like deposit rarely exceeding 9 m in thickness that extends westward from near Rochester, New York into Ontario beneath the Niagara Escarpment to end southwest of Collingwood (Rutka et al., 1991). The lower portion of the Whirlpool is "characterized by a complex of relatively small, shallow, but broad, northwest flowing, sandy braided rivers, characterized by slightly sinuous channel patterns, lateral erosion, and frequent flashy discharges. ... The petrology of the Whirlpool clearly indicates a secondary or multicyclic origin, with fossil fragments suggesting that earlier marine sediments provided the source-material, possibly a shallow-marine facies of the Oswego Sandstone (the eastern equivalent of the Queenston Shale) located in northeastern Pennsylvania and south-central New York." The braided river plain was estimated to have covered an area about 350 km down and at least 200 km across the surface of the Upper Ordovician Queenston muds (Rutka et al., 1991).

The 1890 Royal Commission on the mineral resources of Ontario provides the setting for the quarrying of the brownstone for the Parliament Buildings (Fig. 7).

> The Chisholm quarry on the north side of the river has been denuded of the overlying limestone, ... About three feet of the upper layer consists of grey stone, and the brown is in varying thicknesses below the grey. Where there is a deep basin and the layer thickens in shape, the brown stone improves in quality. The total thickness of the formation varies from 12 to 17 feet. Pick and wedge and plug and feather are both used to get the stone broken up into suitable blocks. Two other quarries are operated on the Chisholm properties, located on both sides of the railway and the river. The other chief quarries... are those of Messers. Patullo [sic], Yorke and Elliot. The Patullo [sic] quarries are two in number, one on the

south side of the stream, below the forks, overhanging the railway track, and the other on the north side of the west branch of the river. The quarries of Lionel Yorke and N.M. Elliott are both on the south side of the main stream, overhanging the railway. Besides these, several smaller quarries have been opened at various points along the escarpment towards the south. The extent of the brown freestone will be limited as the work gets under the limestone covering, which overlies it here to a height of 150 feet, but there is practically an unlimited quantity available. (Report of the Royal Commission, 1890).

As the sandstone near the surface became quarried out, a new technique was employed. As the photo of the Hillis operation claims (Fig. 8) the first stone mine quarries in Canada began here. However at least four of the quarries utilized this method of extraction. (Ontario Bureau of Mines, 1890).

Last year [1889] Messrs. Carroll & Vick began to mine the brownstone at a point where the face showed about twenty-five feet of limestone above fourteen feet of sandstone. Openings have been made along the face of the sandstone for a length of one hundred feet and back to a depth of eighty-five feet, the roof of limestone being supported by timbers and stone. A beginning is made by taking out two or more beds of limestone and putting in supports of timber two or three feet in length. Then the first bed of brownstone is taken out and the work is carried back and down regularly. Limestone and poor grades of sandstone are used to fill the place of the stone removed, at first by the construction of a regular wall four or five feet thick at the opening, and then by a second wall about fifteen feet further on, the intervening space being filled up with rubble. When all the sandstone of a section has been taken out the floor is begun again at the roof and the timber supports carried forward. The brownstone of this quarry is about six feet in thickness, one bed of which is four feet thick. ... Mining work was commenced [in No. 2 quarry] in January of last year in a fine bed of brownstone, which here has a capping of broken shale and limestone about three feet in thickness. The work has been carried in a depth of sixty feet and along a face of seventy-five feet.

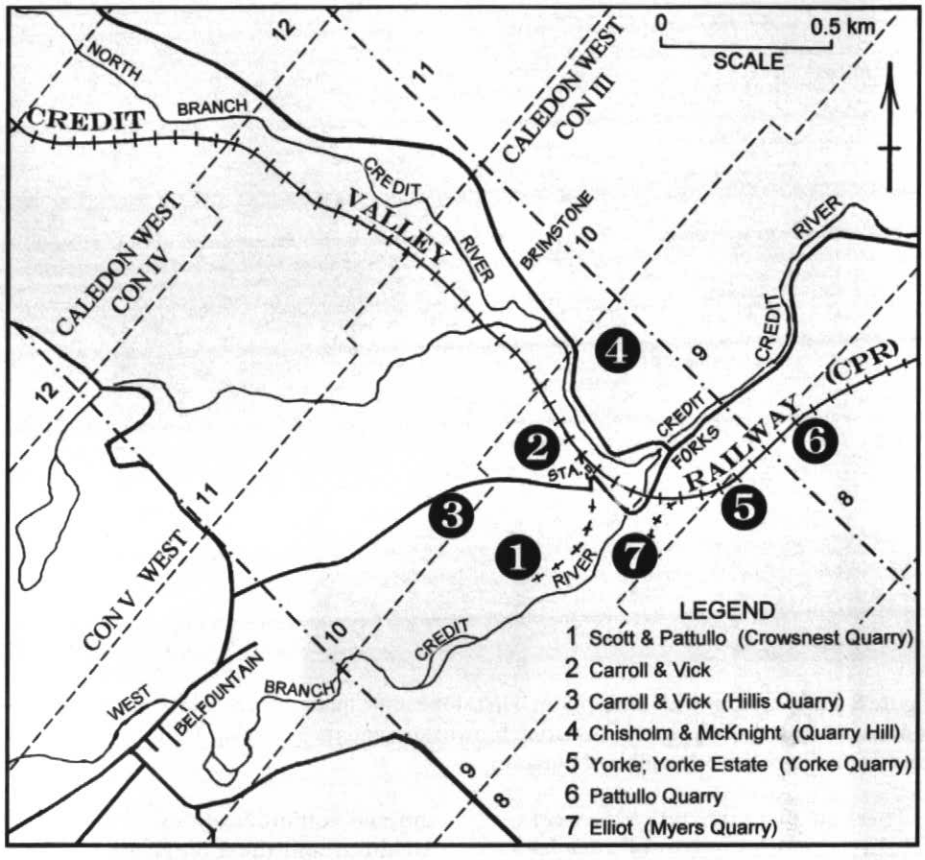

Figure 6 The quarries at the Forks of the Credit supplying stone for the Parliament Buildings.

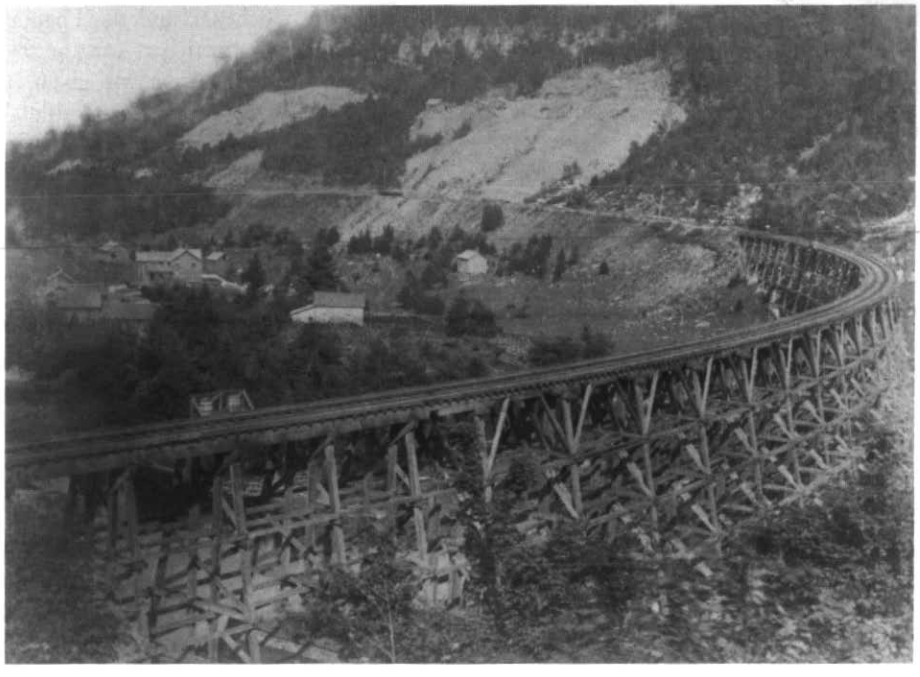

Figure 7 View southeast from near the railway station showing the Yorke quarry (at center), and the Pattullo quarry in the distance. The tramway down to flat cars on the track from the Yorke quarry is visible on the original photograph. The Elliot quarry is just off the photo on the right. (Archives of Ontario, RG 15-74-0-3, AO 5972)

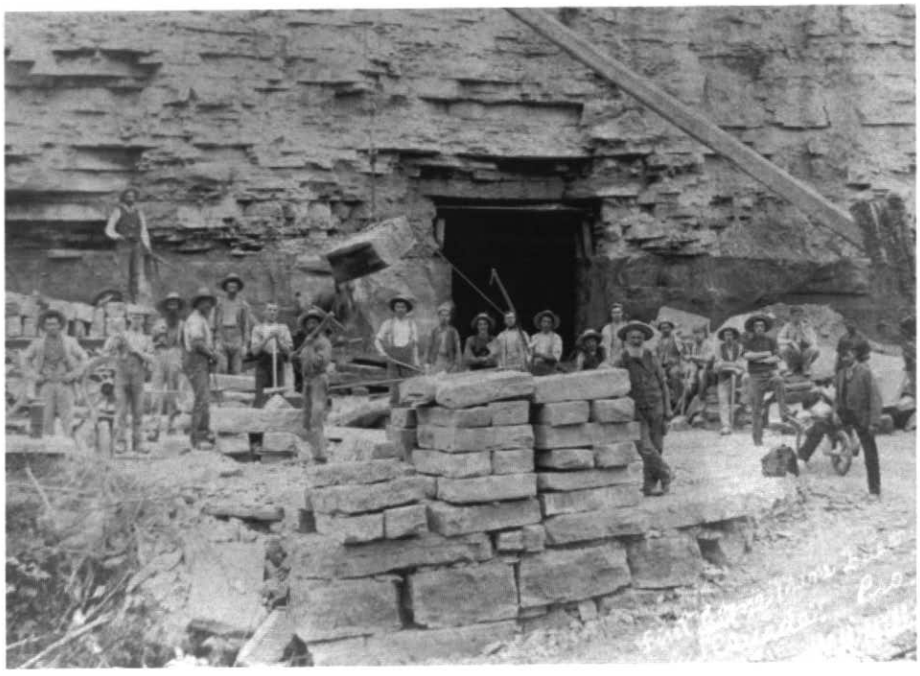

Figure 8 Hillis Quarry with inscription, 'First stone mine quarry in Canada'. Note the sharp contact between the Whirlpool Formation brownstone and the overlying Manitoulin Formation. (Legislative Assembly of Ontario)

> There are two gateways to the works, between which supports of stone have been built back some sixty feet. This quarry yields the best quality of brownstone found at the Forks, the upper bed or course being nine feet and the lower two feet in thickness. One section of the upper bed was found to measure twenty-five feet between joints, and apparently free from checks or dries. (Ontario Bureau of Mines, 1890.)

As quarrying continued, it was found that the quantity of high-quality, large dimensional brownstone required for the Parliament Buildings was insufficient. Presumably this led the architect and contractor to utilize grey Credit Valley stone behind the red with the stone tied into the interior brick masonry (see Fig. 4) to make the walls the required thickness. A report of May 9, 1889 lists 3,742 cubic feet of rough red stone, and 1,769 cubic feet of rough grey stone on site. (AO, RG 15-18-1b). In order to procure the very large pieces specified for portions of the building, the architect asked that an alternate source of large dimension stone be allowed. Kivas Tully summarized the decision of government in his 1892 letter to the acting Commissioner of Public Works. "in reference to the annexed communications of the Architect, and the Contractor for the masonry stonecutting etc. for the new Parliament Buildings respecting the substitution of Connecticut brownstone, for Credit Valley redstone, as specified, in the Porte Cocheres, and the Loggia or front entrance portico ... on the 9th of August, 1890, an order was given ... to the contractors ... for 7500 cubic feet of Connecticut stone at 85¢ per cubic feet." An additional 7500 cubic feet was allowed in August 1892. (AO, RG 15-61b).

The Connecticut stone, Portland Arkose, from the Portland Brownstone Quarries opposite Middletown on the Connecticut River, was first quarried as early as 1645. The letterhead of the contractors proclaimed: "Carroll, Vick & Co. of the Brown Stone Quarries, Credit Forks, Ontario. Also sole agents for the Dominion for the Middlesex Quarry Co's Connecticut Brown Stone, the oldest and best Brown Stone Quarries in the United States." (AO, RG 15-61a). The Portland Arkose was deposited by braided streams dumping sediment into the Connecticut Valley graben (Hartford Basin) during Lower Jurassic (Sinemurian) time 201 million years ago. Its mineralogical composition averaged from four samples is quartz 39%; feldspar 36%; detrital mica and chlorite 8%; hematitic clay 5%; other detrital 3%; porosity 7% (Heald, 1956). Very large blocks could be obtained from this quarry. An 1890 report stated, "Natural blocks 100 by 50 by 20 feet occur, and hence blocks of any desired size may be obtained." (The Manufacturer and Builder, 1890). Crossbedding is common and obvious in the large blocks obtained from this quarry for the Parliament Building. (Fig. 9).

CHANGE AND ADDITION

The government soon outgrew the space available and by 1906 had "under consideration a proposition for fire-proofing as far as possible the present building, the addition of a new library and the utilizing of the present library space for new departments of the Government, as well as the provision for one or more storeys on top of the present walls of the main building" (Nasgaard and Bayer, 1978, Appendix 33). After subdividing rooms as much as possible as stated by the Minister of Public Works: "Alterations have been made ... on the ground and first floors. The water closets which were unnecessarily large have been converted into commodious offices on each floor with entrances from the main corridor, and the room formerly used as a lavatory has been rearranged, giving ample accommodation for W.C.'s, lavatories and urinals." (DPW, 1907). Edward James Lennox (1855-1933) was chosen to alter the West Wing for more office space and George Wallace Gouinlock (1861-1932) chosen to design a new North Wing. Both Lennox and Gouinlock had plans and specifications well in hand by the spring of 1909. (City of Toronto Archives, SC 48, box 3; RG 15-18-1, box 27, file 27-3). The excavation contract for the North Wing addition was let on May 5th.

Lennox issued his first specification in March 1909, "Specification of the brick, cut stone, etc. work including all materials and workmanship required in connection with the erection and completion of Parliament Buildings for the Province of Ontario." (City of Toronto Archives,

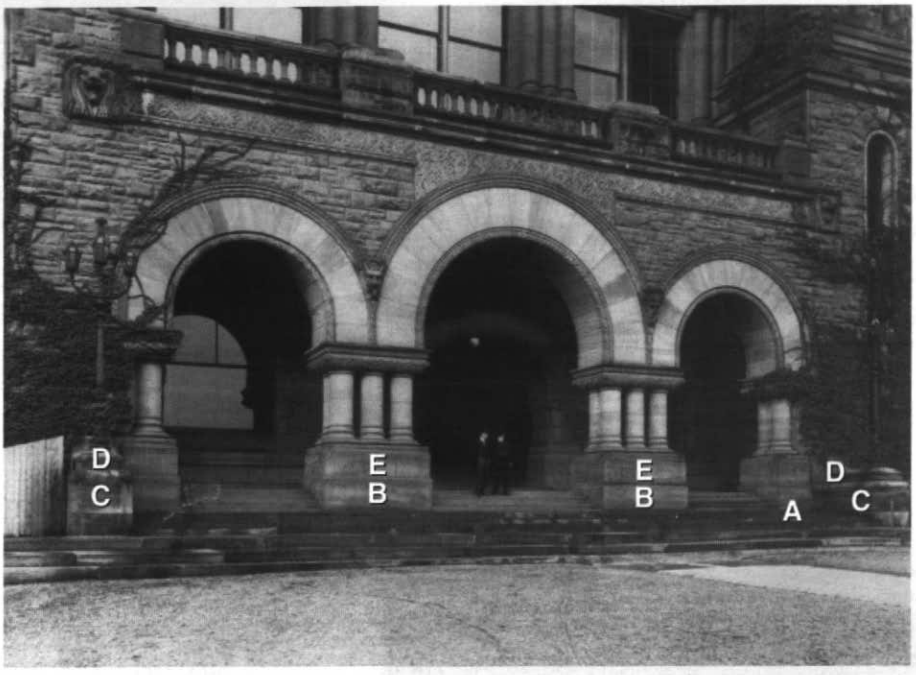

Figure 9 Front entrance of Parliament Building with typical Richardson Romanesque recess. The large blocks beneath the pillars, the pillars, the arcading, and the carved lion heads are of Portland Arkose. Note crossbedding beneath the right-hand pillars (**A**). The wide base stones beneath the columns (**B**) measure 284 x 110 x 81 cm to weigh 5.9 t, and the two stones immediately beneath the columns (**E**) are 178 x 138 x 81 cm (4.65 t ea.). The base stone projecting at the sides (**C**) measures 267 x 122 x 84 cm, while the bench stone supporting the lamp post (**D**) was cut from a block 271 x 91 x 86 cm. Porte Cocheres used blocks as large as 183 x 105 x 56 cm weighing 6.3 t (City of Toronto Archives, Fonds 1244, Item 1213).

SC 48, box 3). Lennox ultimately increased the height of the West Wing by 162 cm to incorporate a fifth floor, and added a fourth floor and dormers along with a decorative skylight in the connecting pavilion to meet the demand for more office space. These changes altered the symmetry of the original design at the top, but after the fire, Lennox rebuilt the front façade of the West Wing with a set of paired windows similar to those of the East Wing to enhance the symmetry at the bottom. (Fig. 10). On September 1, 1909, workmen repairing the roof of the West Wing inadvertently started a disastrous fire that destroyed much of the wing including the library. Lennox was given the task of repairing the fire damage in addition to his contract to enlarge the West Wing. His specifications detailed replacing much that was wood in the original with terra cotta structural tile, steel, concrete and marble (Fig. 11).

As Credit Valley stone was in limited supply, most of the exterior addition and repair were of Nova Scotia, No. 1 River John brownstone (Gardiner, 1985). The contract listed New Brunswick, No. 1 River John Brown Stone, however River John stone is from River John, Nova Scotia. Another source lists River John stone as only being used in the repair of the West Wing. (Nasgaard and Bayer, 1978; DPW, 1910). Gouinlock specified most of the new stone for his North Wing to be New Brunswick, Sackville brownstone (Fig. 12). Construction of the North Wing began in the spring of 1909 and the wing was occupied by mid-1913 (Fig. 1). That the North Wing was built with stone from the Sackville Freestone Co's, Pickard Quarry is confirmed by other reports. (Parks, 1914; Martin, 1990). Parks lists the two River John quarries as quite small with the stone very fine-grained (0.06-0.07 mm), and very similar in color to Credit Valley stone, composed mostly of quartz with "a sprinkling of feldspar grains" and about 2.2 per cent hematitic clay. (Parks, 1914). At the time of his visit all the stone was being shipped to Toronto so it could well have been used in the ashlar repair of the West Wing. The River John quarries reside within the Pictou Group of Late Carboniferous (Stephanian?) age (Donohoe and Grantham, 1989).

The New Brunswick Sackville stone of Late Carboniferous age was deposited upon a broad alluvial plain, from rivers flowing from the Appalachian highlands to the west. It is coarser grained than the River John with quartz grains angular and some exceeding 0.5 mm in length, but most grains are much smaller. Feldspar grains are as common as the quartz and quite decomposed, mica flakes occur speckled throughout, and about 6.5 per cent hematitic clay with some carbonate forms the balance. (Parks, 1914). The Sackville stone has been found to be the least durable of the stones used in the building (Blades, 1991).

Lennox concentrated on making the West Wing as fireproof as possible. He replaced much of the wood with concrete and marble.

The Public Accounts for the years 1909 to 1914 provide details of the costs of materials and contractors used in the reconstruction of the West Wing and the new North Wing (Table 2). For the West Wing, Lennox was paid $29,662.09 with construction totalling $614,417.25. And Gouinlock collected $34,278.95 for the North Wing construction that totalled $644,357.53 (GO, 1910, 1911, 1912, 1913, 1914, 1915). Fortunately, preservation of the building's aesthetics prevailed, allowing Lennox to provide us with another example of his skill in the Romanesque style.

But the growth of government outpaced the construction of all the new space, causing the Minister of Public Works to state, "Owing to the expansion of the work of the Hydro-Electric Power Commission, and the increase of work of other departments of the Government, it was found impossible to find accommodation for all in the new building." (DPW, 1912).

A masonry report prepared by C.A. Ventin Architect Ltd. (Blades, 1991) mentions that "It appears from public records that the repointing and repair of the stonework has been an ongoing issue, at least from the early 1930's. Repointing was undertaken in 1932/33 and virtually continuously in

Table 2 Contractors and costs for the Ontario Parliament Buildings

	Company	Est. cost
Main Parliament Buildings 1886 - 1893		
Architect	R. A. Waite	$ 44,565
Excavation, masonry, brickwork	Lionel Yorke; later Carroll Gaylord & Vick	735,842
Carpentry and joiner work	Lionel Yorke; later Lionel Yorke Estate	90,980
Iron work, etc.	St. Lawrence Foundry Co.	53,844
Plastering, etc.	A.H. Rundle	37,665
Plumbing, steam heating	Purdy Mansell Mashinter	77,665
Slate and copper roofing	Douglas Bros.	44,337
Interior woodwork	Wagner Zeidler & Co.	120,742
Painting, glazing, etc.	R.J. Hovenden	23,325
Outer drainage	Garson & Purcer	5440
Interior fire hydrants, piping, etc.	W. J. McGuire & Co.	1103
Grand staircase	H.C. Harrower	21,939
Other painting, woodwork	Elliot & Son; Rice Lewis & Son; Charles Roger & Sons	12,607
Combination gas and electric lights	Bennett & Wright	27,297
Book stacks, oak counter, grills	William Simpson; Keith & Fitzsimons	7339
Elevators	Otis Bros. & Co.	22,000
Sundry other	Water mains, drains, advertising tenders, etc.	6486
Grounds, roads, pavement, etc.	Various	26,627
West Wing rebuild / restoration 1909 - 1912		
Architect	E. J. Lennox	29,662
Stone and brickwork	Messrs. E. Gearing & J.F. Curtis	materials and labour +10%
Stone supply – New Brunswick	Britnell & Company Ltd.	
No. 1 River John Brown stone	– dimension stone	1.00/cu. ft.
	– promiscuous blocks	0.90/cu. ft.
Stone carving	Messrs. Holbrooke & Mollington	10,188
Hard building brick	Hamilton Brick Co., Ltd. of Toronto	9.00/1000
Fireproofing and concrete	Messrs. E. Gearing & J. F. Curtis	54,000
Steel and blacksmith work	The Dominion Bridge Company Ltd. depending upon the steel work (plain vs riveted)	2.30-3.80 per 100 lbs
Carpentry and joiner work	T. V. Gearing & Co.	materials and labour +9%
Slating and copper work	Douglas Brothers, Ltd.	16,757
Marble work	Hoidge & Son (The Hoidge Marble Works Co.)	32,800
Marble treads to stairs	The Gibson Marble Works Co.	3307
Tile flooring	H. M. Robinson & Co. (The Marble Mosaic Tile Works)	14,240
Marble mosaic tile work	The Italian Mosaic & Marble Co., Buffalo, NY	12,941
Wrought iron work	Dennis Wire and Iron Works Co., Toronto	8946
North Wing addition 1909 - 1912		
Architect	G. W. Gouinlock	34,279
Excavation	Edward J. Breen & Patrick Berford – extra at 85¢/cu. yd.	8500
Concrete footings, walls, piers	Edmund Ashton & John Mullin	15,895
Erection of building and all trades	Messrs. Fred. Holmes & Son	517,534
Marble tablets, lettered and set up	The Mississiquoi Marble Co., Philipsburg, PQ	5346
Bronze tablets and set up	The Canada Foundry Co. Ltd., Toronto	1200
Carpentry, painting, etc.	Various	85,912
Electric lights	Chadwick Bros. Ltd., Toronto	9970

the period between 1948 and 1960. Repairs to the stonework are cited in 1948, 1952, 1954, 1955, 1958, and 1959." (Blades, 1991; Fig. 13, Table 3). The 1970s saw the exterior of the building cleaned and sandblasted, and an extensive program of repointing, stonework repair, and waterproofing undertaken. Following the repairs in the 1970s, another episode of stone repair and replacement using newly purchased Sackville stone to replace all damaged stone occurred from 1983 and into 1989. The difficulty of finding skilled stoneworkers was shown by an article highlighting the stone-carving repair being performed by 78 year old Bill Harvey (Flavelle, 1989).

These stone repairs did not address the leaky roof, non-compliance with 1980s fire regulations, and outmoded plumbing and electrical systems. Following the transfer of responsibility for the Parliament Building to the Office of the Legislative Assembly in late 1988, events moved quickly. In March 1989, a Special Committee on the Parliamentary Precinct was established with terms of reference to "develop, approve, supervise and coordinate the implementation of a programme for the restoration, renovation, rehabilitation, cyclical maintenance and use of the Parliament Building and Grounds, and to implement an interpretative programme, emphasizing public education and understanding of the Parliament Building and its history ..." (OLA, 1991). Julian Smith & Associates was hired as heritage advisor and completed the restoration master plan in 1991.

The report recommended improvements to improve pedestrian access to, and movement within, the building in addition to reopening an atrium and two skylights. (OLA, 1991). The firm, C.A. Ventin Architect, was engaged to examine the building and provide direction for necessary repairs. Beginning in 1992, Phase I, at a cost of $10-million, concentrated on the Centre Block with a new roofing system installed by Buttcon Limited, and stone repair overseen by Clifford Masonry and Restoration. Stone fabrication was by Owen Sound Ledgerock Ltd. with D.J. McRae Contracting Ltd. installing the large slabs of Hulberton sandstone to restore the front steps. Phase II, in 1993, repaired the West Wing with its new insulated roof covering finished with slate from Vermont at a cost of $7-million. The 28,000 sq. ft. of slate for the West Wing was installed by Dean-Chandler Roofing Ltd. (Threndyle, 1993). Phase III, in 1994, focused on the East Wing and cost $8-million. Clifford Masonry and Restoration again oversaw the stone repair. Phase IV, in 1995, completed the first round of

Figure 10 View of Queens Park looking north showing the fourth floor and dormers added by E.J. Lennox to the West Wing of the Parliament Buildings. This addition temporarily met the need for extra office space, but altered the former roofline symmetry of the building. (Toronto Reference Library, T 12055).

cyclical review and repair on the building complex with $7-million of work on the North Wing. Colonial Building Restoration directed the stone restoration and repair of this phase. In 1998 an access ramp was installed, adjacent to the front entrance, for barrier-free access and an entrance for tour groups. A proposed interpretation lobby and display area at this entrance awaits funding.

Stones used for repair or replacement included a small amount of *Credit Valley* for the balusters in the Legislative Chamber balcony, and *Red St. Bees* from sea cliffs near Cumbria, England, a stone much shipped to the US in the 18th and 19th centuries, for carved blocks and dutchman repair. Its mineralogy and competency is described in Hawkins and McConnell (1991). *Plumpton Red Lazonby* quarried from Lazonby Fell, 3 miles north of Penrith, England, a medium-grained high quartz sandstone very resistant to abrasion and weathering so was used for the north entrance steps and rampways. *Hulberton* sandstone from near Clarendon, NY was used for the large slabs required for the front entrance steps (331 x 166 x 14 cm).

Figure 11 Wood floors, iron railings, and wood trim as seen in the left photo (City of Toronto Archives, Fonds 1244, Item 3003A) were replaced with concrete and marble floors of tesserae, and marble trim as seen in the photo on the right (Legislative Assembly of Ontario).

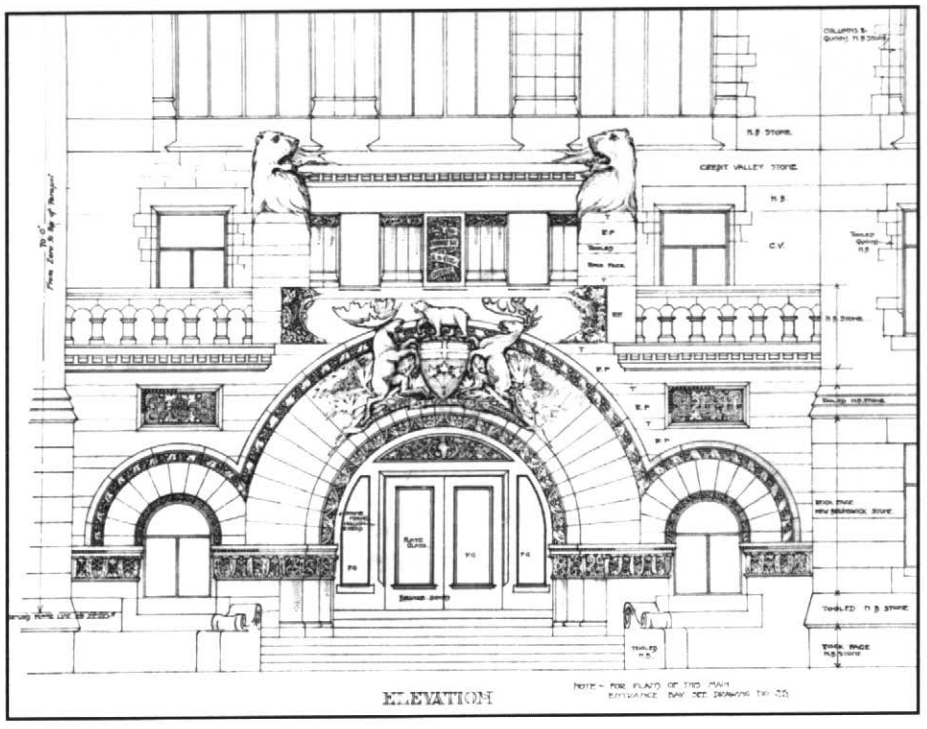

Figure 12 Romanesque entrance to the North Wing designed by G. W. Gouinlock with Credit Valley and New Brunswick stone specified. Tooled surfaces indicated by **T**, and rockfaced surfaces by **R.F.** (Archives of Ontario, RG 15-13-2-134, sheet 11-1-2-22).

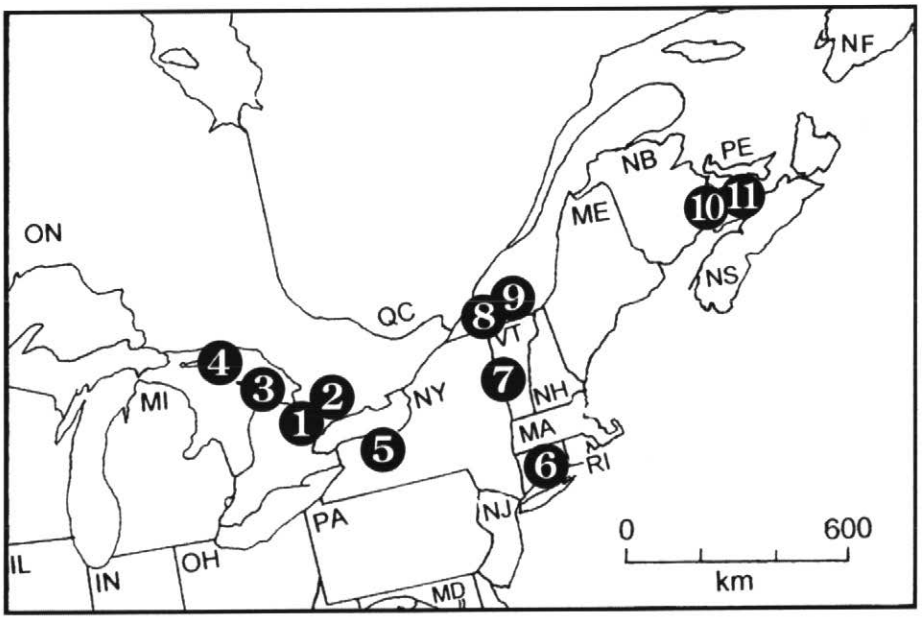

Figure 13 North American sources of dimension stone for the Parliament Buildings. **1.** Credit Valley sandstone, **2.** Longford limestone; **3.** Adair 'marble'; **4.** Silverwater limestone; **5.** Hulberton sandstone; **6.** Portland arkose; 7. Fair Haven slate; **8.** Missisquoi marble; **9.** Rockland slate; **10.** Sackville sandstone; **11.** River John sandstone.

The current review and repair began as required with the Centre Block in 2001-2002 with the firm D.J. McRae Contracting Ltd. directing the stone restoration. The fabrication and repair of stone masonry was contracted to the firm, Carter Richer & Stark stonecarvers and conservation masons. As the major repairs were completed in the first cycle of restoration (Phase I – IV, 1992-1995), the current restoration focused on repointing, crack repair, some algae cleaning, and a few dutchmen repairs. Now with a regular schedule of maintenance the building should easily last for another century. As the saying goes, "an ounce of prevention is worth a pound of cure."

ACKNOWLEDGEMENTS

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REFERENCES

Archives of Ontario (**AO**), 1886, PAMPH 53, Specifications.

Archives of Ontario (**AO**), Series RG 15-18-1a, box 27, file 27-1, Incoming correspondence Parliament Buildings 1880-1886: Report of the committee on 16 designs for new Parliament Buildings, November 15, 1880.

Archives of Ontario (**AO**), RG 15-18-1, box 26, letter from J. Notman to Tully.

Archives of Ontario (**AO**), RG 15-18-1b, box 27, file 27-2, R.P. Fairbairn listing stone on site.

Archives of Ontario (**AO**), RG 15-61a, box 1, file 281, Notice to Architects.

Archives of Ontario (**AO**), RG 15-61b, box 1, file 145, Correspondance of Kivas Tully.

Archives of Ontario (**AO**), C 43-068-0-1.1, box M-050, Specifications - West Wing Parliament Building.

Arthur, E., 1964, Toronto - no mean city: University of Toronto Press, Toronto, Ontario, p. 169.

Arthur, E., 1979, From Front street to Queen's Park: McClelland and Stewart Limited, Toronto, Ontario, p. 54, 69.

Blades, K., 1991, Masonry report, Legislative building Queen's Park: C. A. Ventin Architect Ltd., 14 p.

Table 3 Stone use in the Ontario Parliament Buildings

Stone	Principal use	Source	Age
Limestone	Basement walls	Gull River Formation Longford, ON	Middle Ordovician ca. 465 Ma
Credit Valley sandstone	Exterior walls – main building	Whirlpool Formation Forks-of-the-Credit, ON	Lower Silurian ca.438 Ma
Portland Brownstone	Large stones at main entrance and porte cocheres	Portland Arkose Middletown, CT - USA	Lower Jurassic ca. 201 Ma
River John sandstone	West Wing repair	Pictou Group River John, NS	Late Carboniferous
Sackville sandstone	North Wing addition, and some in West Wing reconstruction	Pickard Quarry, Sackville, NB	Late Carboniferous
Red St. Bees sandstone	Dutchman repair; replacement of some carved blocks. Finials, south side West Wing	New Red Sandstone Whitehaven, Cumbria England	Triassic
Red Lazonby sandstone	North entrance steps and rampways	New Red Sandstone nr. Penrith, England	Triassic
Hulberton Red sandstone	Front entrance steps	Medina Formation nr. Clarendon, NY – USA	Lower Silurian
Black Slate	Roofing	Rutland, VT – USA	Lower Cambrian
Rockland Blue Black Slate	Roofing	Farnham Slate, Melbourne Tp., PQ	Middle Ordovician
Red slate	Interior staircase, landings, flooring	Fair Haven, VT – USA likely quarried in NY	Upper Ordovician
Veined marble	West Wing interior hall walls and pillar cladding	Italy, Lucca area ?	Jurassic
Marble pieces	Mosaic floor and terrazzo floor in West Wing	Italy ? ? ?	
Silverwater marble	North Wing flooring and wainscoting in passage to library; new flooring in basement Main Building	Manitoulin Formation nr. Foxey, Manitoulin Island, ON	Lower Silurian ca. 436 Ma
Adair marble (dolostone)	Accent strips, new flooring . in basement Main Building	Amabel Formation Albemarle Tp., ON	Lower Silurian ca. 427 Ma
Missisquoi vert gris marble	Panels of members names	Strites Pond Formation Phillipsburg, PQ	Late Cambrian ca. 500 Ma

Blumenson, J.J.-G., 1981, 2nd ed., Identifying American architecture: W. W. Norton & Company, New York, New York and London, UK, p. 47.

Canadian Architect & Builder, 1888, The new Parliament Buildings: v. 1, no. 7, July, p. 6.

City of Toronto Archives, Lennox collection: SC 48, box 3.

Department of Public Works (DPW), 1887, Report of the Minister, p. 5.

Department of Public Works (DPW), 1888. Report of the Minister, p. 5.

Department of Public Works (DPW), 1889. Report of the Minister, p. 3

Department of Public Works (DPW), 1890. Report of the Minister, p. 7.

Department of Public Works (DPW), 1891. Report of the Minister, p. 3.

Department of Public Works (DPW), 1892. Report of the Minister, p. 7.

Department of Public Works (DPW), 1907, Report of the Minister, p. 111.

Department of Public Works (DPW), 1910, Report of the Minister, p. 127.

Department of Public Works (DPW), 1912, Report of the Minister, p. 7.

Donohoe, H.V. Jr. and Grantham, R.G., 1989, Geological highway map of Nova Scotia, 2nd ed.: Atlantic Geoscience Society, Halifax, AGS Special Publication No. 1.

Flavelle, D., 1989, Master of a dying craft: Toronto Star, March 16, p. M1, M8.

Gardiner, E., 1985, Ontario's legislative building: Current Issue Paper 36, Legislative Research Service, Ontario, 16 p.

Goudge, M. F., 1933, Canadian limestones for building purposes: Canada Mines Branch, No. 733, Ottawa, 196 p.

Government of Ontario (GO), 1880, Sessional Papers, v.12, part.4, Sessional Paper 52, p. 3-6.

Government of Ontario (GO), 1887a, Sessional Papers, v. 19, part 5, Sessional Paper 28.

Government of Ontario (GO), 1887b, Sessional Papers, v. 19, part 5, Sessional Paper 44.

Government of Ontario (GO), 1910, Sessional Papers, v. 42, pt. 1, p. 262.

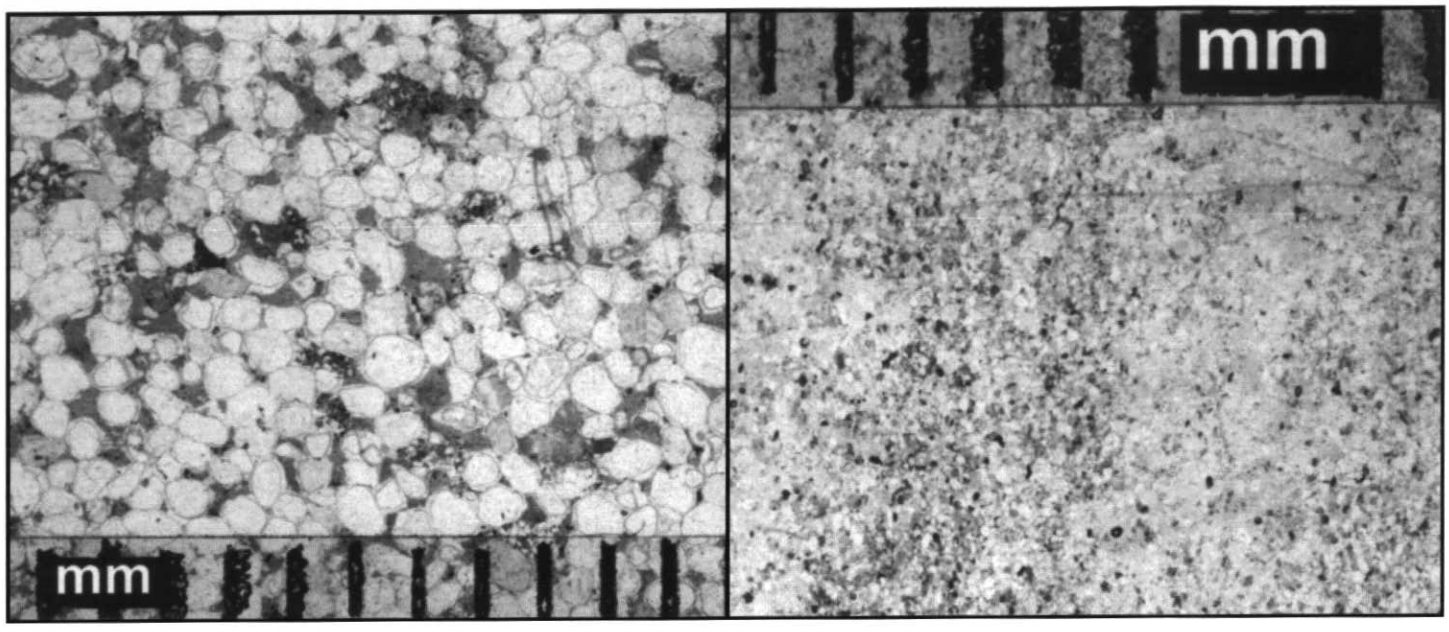

Figure 14 Plane light photomicrographs of sandstones used for repair at the Parliament Buildings. *Plumpton Red Lazenby*, from near Penrith, England (left) – quartz overgrowths surround the hematite coatings on the original grains; *Hulberton (Haldenby) sandstone*, Clarenden, New York (right) – laminations alternate between fine-grained, quartz-rich and coarser-grained opaques with more hematite (Courtesy of Kathleen M. Kemp, Kemp and Freeman, 1998).

Figure 15 Before and after repair. Stonecarver Lawrence Voaides, created in Red St. Bees sandstone, the form of carving interpreted from that in the weathered Sackville sandstone

Government of Ontario (**GO**), 1911, Sessional Papers, v. 43, pt. 1, p. 313-314.

Government of Ontario (**GO**), 1912, Sessional Papers, v. 44, pt. 1, p. 324-327.

Government of Ontario (**GO**), 1913, Sessional Papers, v. 45, pt. 1, p. 338-339.

Government of Ontario (**GO**), 1914, Sessional Papers, v. 46, pt. 1, p. 349-351.

Government of Ontario (**GO**), 1915, Sessional Papers, v. 47, pt. 1, p. 357.

Hawkins, A.B. and McConnell, B.J., 1991, Sandstones as geomaterials: Quarterly Journal of Engineering Geology, v. 24, p. 135-142.

Heald, M.T., 1956, Cementation of Triassic arkoses in Connecticut and Massachusetts: Bulletin, Geological Society of America, Bulletin, v. 67, no. 9, p. 1133-1154.

Hewitt, D.F., 1964, Building stones of Ontario, part 2, limestone: Ontario Department of Mines, Industrial Mineral Report 15, Toronto, p. 31-34.

Karrow, P.F., 1967, Pleistocene geology of the Scarborough area: Ontario Department of Mines, Geological Report 46, Toronto, p. 33-36.

Karrow, P.F., Dreimanis, A. and Barnett, P.J., 2000, Proposed diachronic revision of Late Quaternary time-stratigraphic classification in the eastern and northern Great Lakes area: Quaternary Research, v. 54, p. 1-12.

Kemp, K.M. and Freeman, E.B, 1998, Building stones of Toronto, Field Trip A5: 17th General Meeting, International Mineralogical Association, 12 p.

Lajtai, E.Z., 1969, Stratigraphy of the University Subway, Toronto, Canada: Geological Association of Canada, Proceedings, v. 20, p. 17-23.

Lawrence, D.E., 2001, Building stones of Canada's federal parliament buildings: Geoscience Canada, v. 28, no. 1, p. 13-30.

Martin, G.L., 1990, For love of stone – the story of New Brunswick's building stone industry: Miscellaneous Report 8, Department of Natural Resources and Energy, Fredericton, p. 61-62.

Miller, W. G., 1904, The limestones of Ontario: Report of the Bureau of Mines, pt. II, p. 90-91.

Nasgaard, S and Bayer, F., ed., 1978, A critical summary of archival material relating to the history of the Parliament Buildings, Toronto: Ontario Ministry of Government Services, 85 p. and appendices.

Ontario, Legislative Assembly (**OLA**), 1991, Special Committee on the Parliamentary Precinct: A time for renewal – restoration master plan for the Ontario Legislative Assembly building and grounds, Queen's Park, Toronto, 303 p.

Ontario Bureau of Mines, 1890, Annual report 1, p. 98-99.

Ontario Heritage Foundation, 1989, Quarries at the Forks, an heritage resource assessment of the Willoughby-Cox properties, Town of Caledon: unpublished report, 76 p.

Parks, W.A., 1912, Report on the building and ornamental stones of Canada: v. 1, Mines Branch 100, Ottawa, p. 229-232; 150-159.

Parks, W.A., 1914, Report on the building and ornamental stones of Canada: v. 2, Maritime Provinces, Mines Branch 203, Ottawa, p. 64-66.

Report of the Royal Commission on the mineral resources of Ontario, 1890, Legislative Assembly, Ontario, p. 73-74.

Rutka, M.A., Cheel, R.J., Middleton, G.V. and Salas, C.J., 1991, The Lower Silurian Whirlpool sandstone *in* Cheel, R.J., ed., Sedimentology and depositional environments of Silurian strata of the Niagara Escarpment, Ontario and New York: Geological Association of Canada, Toronto 1991 Field Trip B4, p. 27-34.

Scadding, H, 1873, Toronto of old: Toronto, Adam, Stevenson & Co., p. 399-402.
Sharpe, D.R., 1980, Ontario Geological Survey, Preliminary Map P. 2204, Toronto.
The Manufacturer and Builder, 1890, The Triassic sandstones of Connecticut: v. 22, May, p.105.
Threndyle, R., 1993, Ontario Legislature restored: Toronto Construction News, vol. 11, no. 5, p. 16-21.

GLOSSARY (additional to those listed in Lawrence, 2001)

Ashlar - Masonry having a face of square and/or rectangular stones, either smooth or textured laid in courses of similar height or as broken ashlar with the height of two thinner stones matching the height of a larger stone
Arcade - A sequence of arches supported on pillars or piers
Baluster - A small, circular pillar supporting a railing, used in balustrades
Balustrade - A series of small balusters supporting a coping or cornice forming a parapet or enclosure
Belt or string course - A continuous plain or molded horizontal course marking a division in a wall
Bond stone - A stone that reaches well into or through a wall to hold it together. Mainly used in ashlar-faced walls. Often cut with their width, twice the height of the course
Bushhammered Stone - face hammered to leave a dimpled surface
Coping - Flat stones used to cap the top of walls and balustrades to prevent water from seeping into the stones beneath
Cornice - The highest mold projection on a wall
Dressed or hand dressed - The cutting of quarry blocks by hand to create a stone ready for installation
Dutchman repair - Insertion of a new stone piece to replace the damaged portion of original masonry
Finial - Ornament on top of gables or elevated situations
Freestone - A stone that can be cut freely in any direction without splitting. The best stone for carving
Frieze - A belt course that may or may not have sculpture relief occurring beneath a cornice
Porte Cochere - A covered archway at a doorway to protect passengers from the weather when entering
Quoins - Stones at the corner of a wall emphasized by size, rustication, projection or a different finish
Rock-face finish - The face of the stone is spauled or pitched from a line to produce a rough finish. Good for an appearance of massiveness and for Richardsonian architecture
Roman arch - A semi-circular arch
Rose window - A circular stone window, the interior space filled with carved tracery arranged like spokes of a wheel
Snecked - Roughly squared stone laid up without courses
Terrazzo - A type of concrete in which chips of marble are mixed with cement and ground to a flat surface and polished. Normally used in flooring, sometimes chips other than marble are utilized
Tesserae - Small pieces of flat-faced marble used in mosaic works
Tracery - The ornamental stone work at the upper part of Gothic windows or in a curved window frame
Water table - A string course near the ground usually with a mold along the top to shed water
References: Various sources including, Stone World (1993), Cleveland Quarries – Stonecutter's Manual (1928).

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APPENDIX

Schedule of prices for the new Parliament Buildings, Queens Park – Lionel Yorke (1886) (Nasgaard & Bayer, 1978).

Excavation	14,250 yards	0.45/yd	$ 6,412.50
Temporary drainage			500.00
Concrete in foundations	2,460 yards	4.25/yd	10,452.50
Protection from frost of necessary			250.00
Stone footings in cement mortar	72,820 feet	0.70/ft	50,974.00
Parging footings in cement	915 yards	0.25/yd	228.75
Parging on tunnel, 3 inches thick	330 yards	1.00/yd	330.00
Rubble masonry in walls below ground line			
Cement mortar	107,150 feet	0.50/ft	53,575.00
Brick backing in stone walls in cement; mortar	12,250,000	15.00/1000	183,750.00
Segmented bricks in floors and tunnels	256,000	16.00/1000	4,104.00
Concrete pugging over vaulted floors average			
9 inches deep	2,200 square yards	0.70/sq.yd	1,540.00
Concrete, etc for arches			1,000.00
Build in cast iron manholes in tunnel			
(Iron work not included)			100.00
Flue linings and timbles	2,500 feet	0.20/ft	506.00
Terra Cotta flues for ventilation			562.00
Assist in setting iron work			250.00
Scotch fire-brick	198,600	30.00/1000	5,940.00
Hollow brick	6,500	30.00/ ?	325.00
Two large size soot doors in stack			30.00
Bars for ladders in chimneys			25.00
Cut stone in walls, steps, etc.	200,000 feet	2.00/ft	400,000.00
Shoddy facing in wall	7,760 yards	4.00/yd	31,040.00
Carving to add			39,447.00
			791,341.75
Contingencies			17,658.25
Tender of September 2, 1886			**$809,000.00**
Deductions			
Change of bond in brickwork, and lump lime for cement			13,750.00
Change of price from Chisholm for stone			43,000.00
Revised tender of October 1, 1886			**$752,250.00**