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R. A. Burwash, D. M. Cruden et R. Mussieux

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Aller au sommaire du numéro

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Résumé de l'article

L'édifice de la législature de Ã Alberta destyle Beaux-arts, a été construit sur lepromontoire de la rive nord de la rivièreSaskatchewan nord à Edmonton.L'excavation du site a débuté en 1907 etles travaux de plâtrage se sont terminéen 1913- Le revêtement des murs dusous-sol et du rez-de-chaussée proviendt'une granodiorite grise extraite d'unecarrière d'une île de l'anse Jervis enColombie-Britannique. Le revêtementdes étages supérieurs provient d'un grèspaléocène de la vallée de la rivière Bowdans le sud de Ã Alberta. Lesmagnifiques piliers corinthiens duportique principal en grès de l'Ohiosoutiennent les armoiries de la provinceen marbre du fronton. Des plaques demarbre de Phillipsburg au Québeclambrissent les murs de la rotonde etforment le grand escalier menant àl'enceinte de l'Assemblée législative.L'enceinte de l'Assemblée législative estdécorée d'un magnifique marbrescrpentinisé de Pennsylvanie.

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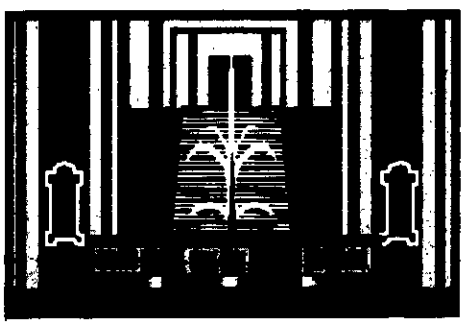

The Geology of Parliament Buildings 2. The Geology of the Alberta Legislative Building

Burwash, R.A.
Dept. of Earth and Atmospheric Sciences
University of Alberta
Edmonton, AB T6G 2E3

Cruden, D.M.
Dept. of Civil and Environmental Engineering
University of Alberta
Edmonton, AB T6G 2G7

Mussieux, R.
Provincial Museum of Alberta
Edmonton, AB T5N 0M6

SUMMARY
Alberta's Legislative Building was constructed in Beaux Arts style on the crest of the north bank of the North Saskatchewan River in Edmonton. Excavation for the foundations began in 1907; the interior marble and plaster work was completed by 1913. The exterior walls of the basement and first storey were built with grey granodiorite quarried from islands in the mouth of Jervis Inlet, British Columbia. The upper stories consist of Paleocene sandstone from the Bow River valley of southern Alberta. The splendid Corinthian pillars of the main portico required Ohio sandstone to support the Provincial Coat of Arms on the pediment. Marbles from Phillipsburg, Quebec panel the walls of the Rotunda and form the Grand Staircase up to the Legislative Assembly. The Chamber is decorated with spectacular green serpentine marble from Pennsylvania.

RÉSUMÉ
L'édifice de la législature de l'Alberta de style Beaux-arts, a été construit sur le promontoire de la rive nord de la rivière Saskatchewan nord à Edmonton. L'excavation du site a débuté en 1907 et les travaux de plâtrage se sont terminé en 1913. Le revêtement des murs du sous-sol et du rez-de-chaussée provient d'une granodiorite grise extraite d'une carrière d'une île de l'anse Jervis en Colombie-Britannique. Le revêtement des étages supérieurs provient d'un grès paléocène de la vallée de la rivière Bow dans le sud de l'Alberta. Les magnifiques piliers corinthiens du portique principal en grès de l'Ohio soutiennent les armoiries de la province en marbre du fronton. Des plaques de marbre de Phillipsburg au Québec lambrissent les murs de la rotonde et forment le grand escalier menant à l'enceinte de l'Assemblée législative. L'enceinte de l'Assemblée législative est décorée d'un magnifique marbre serpentinisé de Pennsylvanie.

GENERAL INFORMATION
Alberta's Legislative Assembly meets in Edmonton, the provincial capital, in an imposing domed edifice first termed the Parliament Building, later, the Legislative Building and sometimes simply the Legislature, the Ledge or the Dome (Fig. 1).

The 27 acre (11 hectare) site occupied "that portion of the Hudson's Bay Company's reserve known as the Old Fort Site which consists of a rounded hill and plateau standing well out in the North Saskatchewan Valley and commanding a most magnificent view of up and down the stream east and west" (Annual Report, 1908, p. 49).

The building was designed by Allan Merrick Jeffers, who left its completion to Richard Palin Blakey who succeeded him as Provincial Architect. Blakey was responsible for the design of portions of the building's interior, notably the Rotunda and the Grand Staircase leading to the Legislative Chamber. The building was designed in the Beaux Arts style, the prevalent style of U.S. state capitols in the period from 1890 to 1930. Jeffers trained in Rhode Island, where the State Capitol in Providence was designed in this style in 1891 (Bodnar, 1979, p. 37). The architect stated "the building is designed on strictly classical lines following the lines of the Corinthian order" (Annual Report, 1909, p. 50).

The building was constructed by contractors under the supervision the Alberta Department of Public Works. Contracts were let for the structural steel to the Structural Steel Co., Montreal and the Canadian Bridge Co., Walkerville; for electrical wiring to Cunningham Electric Co., Calgary; plumbing, heating and ventilation work went to A. Lee and Company of Edmonton. The granite for the exterior was supplied by Kelly and Murray of Vancouver; the Alberta sandstone by the Quinlan Carter Co. of Edmonton from the Alberta Government-owned Glenbow Quarry. Interior marble came from the Missisquoi Marble Company,

Phillipsburg, Quebec and from the C.K. Williams quarry in Easton, Pennsylvania.

Excavation by steam-powered shovel (Fig. 2) began in August, 1907 to an average depth of 4 m largely in "a hard glacial clay containing a few boulders" (Annual Report, 1908, p. 69). Concrete pours for the foundation walls began in October and "work was carried on continually throughout the winter, which made necessary the heating of the materials used" (Annual Report, 1908, p. 70).

The interior column foundations, 91 in all including the foundations for the dome, were put in during the summer of 1908. The first steel of the building's skeleton was placed on August 26, 1908 and by year-end about 500 tonnes of the 1100 tonne frame had been erected and riveted. The frame was completed up to the main floor level and then the erection of the masonry walls began with the placing of the first granite (for the basement storey, entrance steps and balustrades) on May 18, 1909.

The setting of the granite, backing it with brick and laying the interior brick walls continued through the summer of 1909 so that, when the cornerstone of the building was laid on October 1, the main walls of the building were approaching completion up to the first floor, the line of the top of the granite (Fig. 3). Shortages of stone and brick delayed construction of the main building but the tunnel connecting it to its powerhouse adjacent to the Edmonton, Yukon and Pacific Railway siding was finished. Severe weather terminated work on the sandstone masonry upper walls below the second floor in December, 1909 (Fig. 4).

In 1910, "masonry work was energetically continued throughout the season and cut stone set as fast as received. When this part of the work closed for the winter about two-thirds of the entire stone work was completed" (Annual Report, 1910, p. 37).

By the summer of 1911 much of the exterior of the building was complete (Fig. 5) and the Legislative Assembly first met in the building on November 30, 1911. The Governor General, the Duke of Connaught, officially opened the building on September 3, 1912. He saw the dome still incompletely covered with terra cotta tiles, rather than the copper sheeting originally considered. The interior marble and plaster work was completed in 1913.

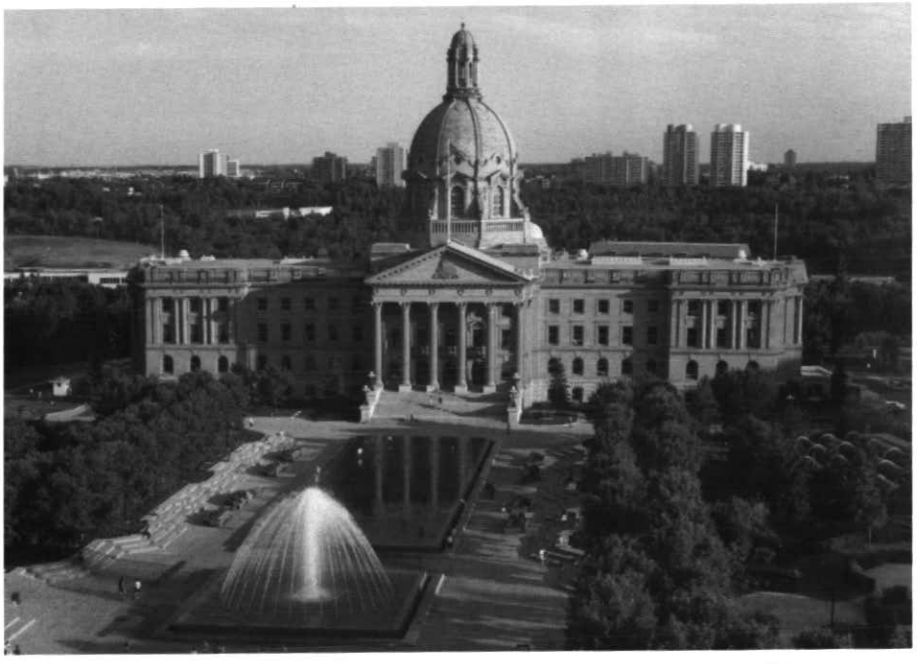

Figure 1 The Legislature from the north in 1989. The Corinthian columns of the main entrance support the provincial coat of arms on the pediment. The fountain and the reflecting pool were added in the extensive landscaping for the province's 75th Anniversary (Alberta Legislature Visitor Centre photograph).

Figure 2 Steam-powered shovel excavating for the foundations of the Legislature (Provincial Archives of Alberta, B3354).

The building has been subsequently renovated and additions made. A fountain was added to the Rotunda for the 1959 Royal Visit and a carillon commemorates the 1967 Canadian Centennial. An exterior fountain with a reflecting pool was part of the extensive landscaping of the new

Figure 3 The recently completed granite walls of the Legislature support the contractor's sign in 1909. Allan Jeffers, the architect stands with building superintendent, John Gillespie and unidentified coworkers to his right. Steampowered cranes in the background were used for placing stone. The doorway behind the coworkers reveals the brick backing of the stone (Glenbow Archives, NA 10428).

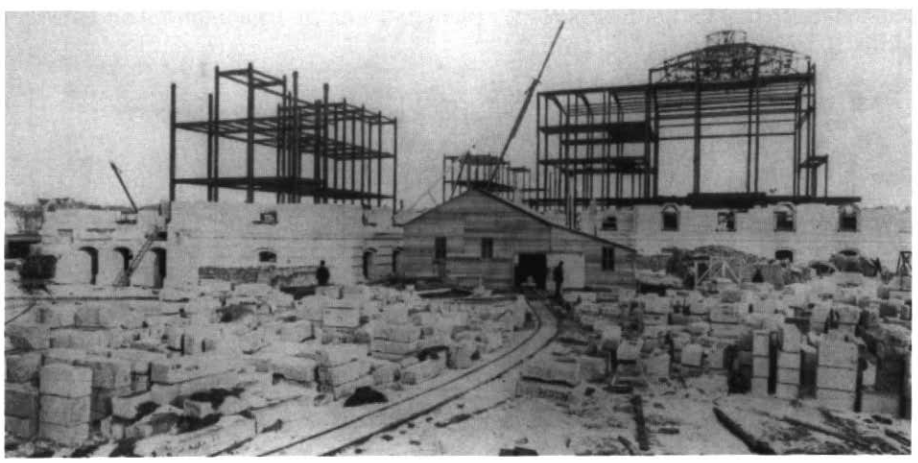

Figure 4 Storage area on the southwest side of the Legislature for sandstone blocks and bricks. The narrow gauge railway ran from the spur in Figure 6 into the cutting sheds visible in the middle distance. The elaborate steel skeleton of the Legislative Chamber on the south side of the building has been erected (Provincial Archives of Alberta, A 11027).

grounds that heralded the province's 75th anniversary (Fig. 1).

The cost of the Legislative Building, landscaping, heating tunnel and powerhouse, as well as the Seventh Street Bridge approach totaled $2,193,731.56 by the end of 1912. Small appropriations in 1913 rounded the cost to about $2.4 million. Multiplying by five gives a rough estimate of the cost at 1975 prices for the building at $12 million (Fischer, 1996). The land acquisition and landscaping undertaken at that time was believed to have added about $62 million to the cost. This $74 million cost base might be multiplied perhaps over four times to estimate 2002 costs at about $300 million for the Building, its grounds and their infrastructure.

BUILDING STONES

Parks (1916, p. 231) noted that "the buildings of the Legislative Assembly in Edmonton are built very largely of Glenbow stone, some yellow Paskapoo sandstone from other quarries and a little Ohio sandstone and Indiana limestone. The basement is of British Columbia granite". These are the stones that are used in the exterior of the building and this paper follows the sequence of the builders, starting with the basement granite and finishing with the marbles that decorate the interior (Table 1).

British Columbia Granite

The granite supplied by the Kelly and Murray Co., Vancouver, was likely from the quarries the company operated on Kelly (49° 42'N, 124° 13'W) and Fox (49° 43'N, 124° 13'W) islands in the mouth of Jervis Inlet, British Columbia (Parks, 1917, Fig. 1 and p. 88). These small islands are north and west of Nelson Island on the northeast shore of Malaspina Strait. The quarries were developed in the Coast Plutonic Complex, intrusions that have been dated as Early Cretaceous by analysis of zircons from the Sechelt Peninsula (Van der Heyden, 1992).

Quarries producing the gray granodiorite typical of the Jervis Inlet stone were examined by Parks in 1915. The West Coast Granite Co., the American-owned successor to Kelly and Murray, was not operating the offshore quarries at the time of Parks' visit, though the product was said to be in demand for both building and monumental purposes. The quarries had recently supplied stone for the Federal Buildings in Seattle, the Victoria harbour breakwater and the Post Office and Bank of Commerce buildings in Vancouver. White and Hora (1988,

p. 12) provided a detailed map of the quarries. Parks (1917, Plates 20, 21) illustrated them.

The rock is a biotite granodiorite. Parks (1917, Plate 18, p. 85) described the Nelson Island stone as "Grey granodiorite of medium texture...essentially the same as the stone from...Granite (Kelly) Island.... The black minerals are chiefly biotite but a little horneblende and a few grains of magnetite are present. Some of the orthoclase crystals show incipient decay but the plagioclase is usually quite fresh".

The stone used in the Legislature is remarkably free of the mafic inclusions (schlieren) and iron sulphides that can detract from its appearance. Examination of a thin section of a specimen in the University of Alberta Museum's collection also shows little evidence of late or post-magmatic alteration. The plagioclase occurs as strongly zoned, euhedral to subhedral crystals showing only minor saussuritization of the calcic cores. The orthoclase has occasional dustings of kaolinite along cleavage planes. The biotite shows minor alteration to chlorite; the iron oxides have no visible alteration.

The stone was likely transported by barge to Vancouver, cut to shape there and moved by rail to Edmonton. There, "a siding 700 feet in length was constructed on the Edmonton, Yukon and Pacific branch of the Canadian Northern Railway along the face of the hill where this road passes and at a distance of 80 feet below the plateau on which the building is being erected...two five-ton stiff leg derricks were set up....One of the derricks was erected on the face of the hill so that the boom would command the cars on the siding and also be able to land the material on a trestle erected out from the top of the hill. The other was set up in the material yard. From the building to the top of the hill, a distance of 500 feet, a light railway was constructed on which was transferred all material" (Annual Report, 1908, p. 71) (Fig. 6).

Sedimentary Rocks

The major building stone used for the exterior of the building is a sandstone

Table 1 Building stones of the Alberta Legislature

Exterior Stone	Principal Uses	Source
Nelson Island granodiorite	Lower walls; steps to north and east entrances	Kelly Island, B.C.
Glenbow sandstone	Upper walls and parapets; columns at side entrances	Cochrane, Alberta
Ohio sandstone	Columns flanking principal, north entrance	Berea, Ohio
Bedford limestone	Column capitals at north entrance?	Bedford, Indiana
Interior Stone		
Missisquoi Mottled grey marble	Floors of rotunda; handrails and pedestals of grand staircase	Philipsburg, Quebec
Missiquoi Light grey marble	Wall panels, rotunda and corridors	Philipsburg, Quebec
Missisquoi Regina marble	Columns in rotunda; wall panels	Philipsburg, Quebec
Missisquoi Vert Rose marble	Borders around wall panels, rotunda and corridors	Philipsburg, Quebec
Serpentine marble	Door frames and base of pillars in Legislative Chamber	Easton, Pennsylvania

Figure 5 The Legislature from the south bank of the North Saskatchewan River. The High Level Bridge and the dome of the Legislature are under construction. Fort Edmonton still stands on the crest of the north bank of the river overlooking the Edmonton Yukon and Pacific Railway (Glenbow Archives NC663752).

Figure 6 Siding from the Edmonton, Yukon and Pacific branch of the Canadian Northern Railway for the delivery of steel and stone for the Alberta Legislature. A five ton stiffleg derrick handed materials from the cars to a trestle and light railway on the top of the hill. To the southeast across the North Saskatchewan River the skyline of the town of Strathcona can be seen (Provincial Archives of Alberta, A 11017).

from the Glenbow quarry (51°10'N, 114°23'W), about 6 km southeast of Cochrane, Alberta. The quarry was developed on south-facing cliffs above the Canadian Pacific main line (Fig. 7), about 25 km west of Calgary in the Bow River Valley. The quarry location in the Dominion Land Survey is the northeast quarter of Section 28 Township 25 Range 3 West of 5th Meridian (Fig. 7). Sandstone from this quarry was the preferred stone for the entire exterior of the Legislature above the first floor up to the dome.

The quarry is in Paleocene Paskapoo Formation (Hamilton *et al.*, 1999). The rock is a lithic arenite with calcite cement. Parks (1916) commented (p. 191):

> "The original Paskapoo sandstone consists, as to mineral grains of about one-third quartz, one third semi-decomposed feldspar and one-third dark-coloured, indeterminable grains of a ferro-magnesian character. These components vary somewhat, and in consequence, there is a more or less defined pepper and salt effect according to the amount and clearness of definition of the darker grains. The original stone has a high content of lime carbonate in the cement: it is to this substance that the stone owes its hardness and it is to its solution and removal that the altered stone owes its softness and greater porosity".

Figure 7 The Glenbow Quarry, 25 km west of Calgary on a siding from the Canadian Pacific Railway in the Bow River valley. Stone, quarried towards the crest of the valley was cut and trimmed in the shops below before being carried by the inclined tramway to loading facilities on the railway spur (Glenbow Archives, NA1025-1).

Further, on page 194, Parks (1916) concluded, "The average stone, however optimistic we might desire to be, is not really a first class sandstone for monumental structures".

Bodnar (1979, p. 29) noted that "the larger slabs of sandstone eventually had to be brought from Ohio, as the time involved in securing large, flawless slabs from the Glenbow quarry became prohibitive". Ohio sandstone is largely from quarries at Berea, 22 km southwest of Cleveland, Ohio. The Berea sandstone, a grey sandstone which weathers to buff, consists of rounded to subangular quartz, chert and altered feldspar grains with some small calcite grains (Moorhouse, 1959, Fig. 173B, p. 344). The stone was also used in the Federal Parliament Buildings in Ottawa (Lawrence, 2001, his Table 2); Lawrence provided recent ASTM test data (p. 20) and referred to Brownocker (1915) and Pepper *et al.* (1954) for more details of performance and petrography. The stone presumably was shipped by rail to Edmonton and handled in the same way as other masonry arriving at the Edmonton, Yukon and Pacific spur. The first Ohio stone arrived in January, 1911 (Edmonton Capital, June 26, 1911).

The costs of shipping the stone across the continent would ensure that Ohio sandstone was used only where the local sandstone had been found to be inadequate. The six prominent Corinthian sandstone columns that support the main entrance of the building were the first fluted columns in Edmonton. The cylinders that make up the columns are 1.2 m in diameter and 1 m in height. The flutes were cut by a milling machine operated onsite by Quinlan Carter staff. The slightly lighter and more uniform tone of the columns is hardly noticeable in contrast with the Glenbow stone but suggests that the use of the Ohio stone is limited to these columns.

Documents in the Legislature library (Stolee, 1978; Anonymous, 1947) claimed that the columns are limestone from Bedford, Indiana, but examination of the columns provides no support for these assertions. Bedford limestone, however, may have been used for the capitals of the columns, perhaps the most elaborate and daring stone carving on the building (Fig. 8). The sculptor, M. Clutterbuck, from London, U.K., would have required uniform, easily carved stone for the delicate representation of individual acanthus leaves curling in nearly full circles. Bedford limestone, the most widely-used stone in the United States, is quarried 60 km south of Indianapolis, Indiana. This oolitic limestone from the Mississippian Salem Formation (Rooney, 1970), might be compared with the Portland limestone familiar to English masons. The passage of time has shown the stone weathers to match the Glenbow stone and may have been used for other carvings on the building, including perhaps the Provincial Coat of Arms on the pediment above the north portico (Fig. 1).

Marbles

The interior of the Legislature is decorated with marbles from the Missisquoi Marble Co. quarry on the shores of Lake Champlain at Phillipsburg, Quebec, about 60 km southeast of Montreal. Parks (1914, his Fig. 10) provided a map. Lawrence (2001, Table 3) noted the use of these marbles in the Federal Parliament Buildings. The marble occurs at the western edge of the Taconic thrust belt and is part of the Strites Pond Formation of late Cambrian age (Salad Hersi *et al.*, in press). The formation was slightly deformed and metamorphosed to low greenschist grade during the Taconic Orogeny in the Middle Ordovician resulting in marble with a wide range of colours and fabrics that are assigned to a variety of named ornamental stones.

The marbles panel the walls of the ground and first floor of the Rotunda, (Fig. 9), form the Grand Staircase up to the Legislature

Chamber, (Fig. 10), and support the colonnade around the fountain. Particular stones, Mottled, Light Grey, Regina and Vert Rose, can be identified from Parks' (1914) descriptions. Mottled, which is medium to light grey, and fine-grained with knots and irregular bands of coarse, white calcite (Parks, 1914, p. 213, No. 711) forms the handrails, pedestals and bases of the Grand Staircase. Light Grey is lighter in colour than Mottled, with the knots and bands smaller or absent (Parks, 1914, p. 214, No. 714). Regina is a white stone with faint yellowish green veining used in the columns; panels, cut parallel to bedding, show wider veins (Parks, 1914, p. 213, No. 715a). Vert Rose has light to medium green, contorted bands that enclose veins and lenses of white to pink calcite (Parks, 1914, p. 215, No. 719) and is used in paneling.

The decorative green stone used in the door frames and baseboards of the Legislative Chamber was being described as being, "from Easton, Pennsylvania" (Anonymous, 1947). This source has been confirmed using a comparative suite of hand specimens from the C.K. Williams quarry, north of Easton, generously collected by Robert C. Smith, II of the Pennsylvania Geological Survey. Distinctive features of the rock from this particular quarry are the presence of pink dolomite metacrysts in a matrix of serpentine and tremolite as well as structural features indicating strong deformation (Peck, 1911, p. 17-18). These features are also visible in the polished serpentine marbles of the Legislative Chamber. F.B. Peck's 1911 report indicated that rough blocks of this unusual ornamental stone were still being produced at the time the Legislature was under construction. The serpentine marbles at Easton occur within the Precambrian Franklin limestone belt, which extends across northwestern New Jersey.

Figure 8 The carving of composite Corinthian capitals for columns and pilasters in the portico of the north, main entrance of the Legislature. Carved Alberta roses (the provincial flower) surmount oeils de beouf and acanthus volutes (Glenbow Archives, NA 1042 –10).

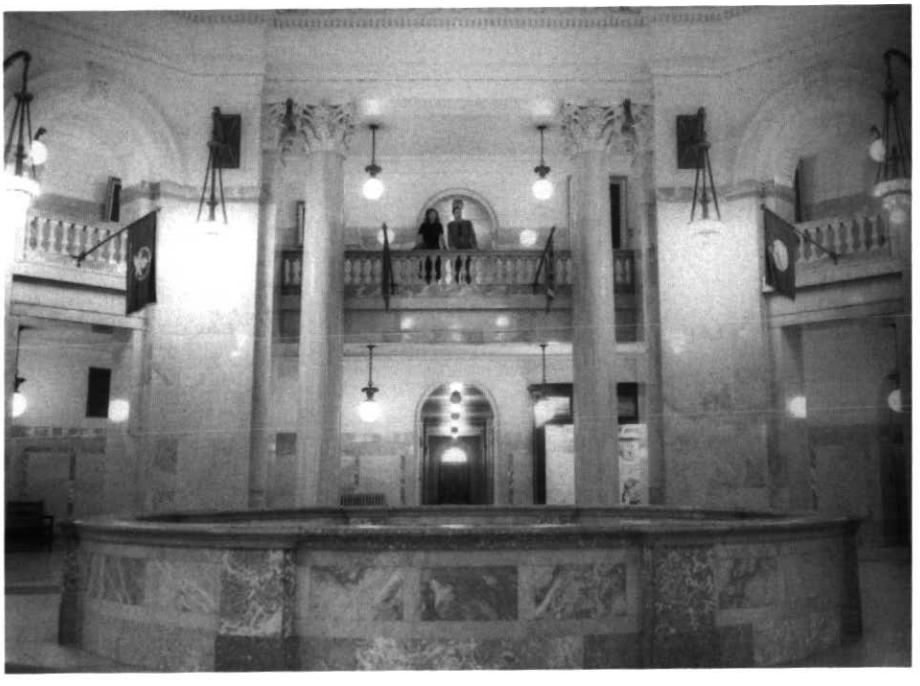

Figure 9 Quebec marble paneling the Rotunda and the fountain on the main floor of the Legislature. The Corinthian gilded capitals are supported by marble columns. The balustrade on the first floor is also marble (Provincial Archives of Alberta PA 43/10).

OTHER INFORMATION

The foundations of the Legislature were further explored in the excavations for the extensive landscaping of the late 1970s (Rains and Welch, 1988) and for the construction of the Light Rail Transit, a decade later and a city block to the west (Feltham, 1994). The succession of till overlying preglacial sands and weathered sandstone bedrock at the Legislature is replaced northwards by deposits of sand and gravel forming the highest of the postglacial terraces of the North Saskatchewan River. Bone fragments recovered from the terrace deposits have radiocarbon ages of about 11,000 years before present (Rains and Welch, 1988, Figure 6).

Figure 10 Grand staircase leading to the Legislative Assembly Chamber on the first floor of the Legislature. The floor of the Rotunda, the steps and balustrade of the staircase are in Quebec marble as is the paneling of the colonnade (Provincial Archives of Alberta PA 43/12).

There has been severe deterioration of the building's Paskapoo sandstone surfaces as a result of inadequate provision for proper insulation and drainage when the building was constructed (Braithwaite, 1995). A restoration project begun in the summer of 1994 saw damaged sandstone repaired by a mortar mix or replaced by similar stone salvaged from the demolished Edmonton Court House (Parks, 1916, Plate 40). Copper flashings were placed to protect sandstone surfaces. While the terra cotta tiles that clad the dome and lantern of the building are in good condition, the mortar holding the tiles has worn and cracked. A less rigid mortar replaced the mortar on the dome and the lantern in 1954 and has been renewed at intervals.

Finally, "Apart from these somewhat practical considerations, the historic side should not be lost sight of, as it commands, what in days gone by....was the most strategic position on the banks of the North Saskatchewan River and one of the most important trading posts of the Hudson's Bay Company in the then North American wilds....we are, after all only aiming to establish for our people the most important and imposing structure in the province upon a site...well suited for the purpose and in doing so following in the footsteps of the Officers of the historic trading company who established themselves upon the same ground some two generations before." (Annual Report, 1908, p. 49-50).

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