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SOMMAIRE

Au Canada, la fabrication de pierre artificielle à partir de béton date du début du siècle. L'un des types, la pierre romaine, était beaucoup employé et on lui donnait des formes et des textures très décoratives. L'article décrit la technique de fabrication par coulage du béton dans un moule en sable et fournit des exemples de son utilisation en construction.

ROMAN STONE AND OTHER DECORATIVE ARTIFICIAL STONES

by

T. Ritchie *

The portland cement and concrete industries that became such an important part of construction and building in the early years of this century had their beginning in the experimental work of Joseph Aspdin, the English bricklayer, in making artificial stone. In 1824 a patent was issued to him for his invention of "an improvement in the modes of producing an artificial stone"[1]. The material Aspdin made he called portland cement, after the natural Portland stone it resembled. It was, in his words, "...a cement or artificial stone for stuccoing buildings, waterworks, cisterns or any other purpose to which it may be applicable...."

Artificial Stone in Canada

A decade after Aspdin's patent was granted, a Canadian patent was issued for a hydraulic cement developed by Frederick Baddely,[2] an officer of the Royal Engineers stationed at Quebec. Subsequently in Canada, there was sufficient interest in the manufacture of hydraulic cements and in the products made from them that when the Universal Exhibition was held in Paris in 1855 several displays of cement and cement products were included in the Canadian exhibit.[3] For example, Pierre Gauvreau, a resident of Quebec who had patented in 1854 his "... new and useful cement, to be called by him Gauvreau's Canadian hydraulic cement,"[4] sent samples of the stone from which he made his cement, some artificial stone formed from it, as well as a pipe made from the cement. Other samples of hardened hydraulic cement were displayed by Thomas C. Keefer, the prominent engineer.

In spite of this early Canadian interest in artificial stone, its extensive manufacture and use did not come about for another half-century, when in the last decade of the 19th century a Canadian portland cement industry was established. Engineers began to employ concrete in large quantities, to the extent that in 1896 the *Canadian Engineer* noted that "Of late, monolithic works of great importance have been carried out and every day concrete as building material is creeping to a foremost place."[5]

Concrete's impact on traditional masonry construction was also noted in a report by the Ontario Bureau of Mines prepared in 1904; "The use of limestone in the form of blocks for building and structural purposes has been considerably affected during the last ten years or so by the

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substitution of concrete - crushed stone and cement. Formerly, for instance, dimension stone was used exclusively in bridge work and for locks and other canal structures ... (but) ... concrete is being used in place of stone...." The new material was also being applied to building construction; "some large buildings in the Province are built of concrete... (and)...concrete blocks, which resemble those of stone, are also coming into use."[6]

In summary, by the turn of the century, artificial stone had been introduced to the Canadian building industry and had been accepted by it; "...cement is proving a formidable competitor to stone for uses in which the latter was for long employed almost exclusively. Quarrymen look askance at the new material which is replacing their product in bridge work, foundations and construction work of various kinds, contending that it will prove less durable and more liable to destruction by frost when exposed to the action of water. Time only will show whether these imputations are warranted, but in the meantime there is little doubt that cement for many uses is pressing hard on stone."[7]

The Roman Stone Company

As a result of the demand for concrete, by the first decade of this century all large Canadian communities, and many small ones, were served by a concrete block factory. There were also a few manufacturers of ornamental artificial stone, the largest the Roman Stone Company of Toronto. This firm, established in 1903, produced a decorative stone called "Roman Stone" by a process developed and patented in the United States by C.W. Stevens just before the turn of the century.[8]

The Stevens Process

In the Stevens process, the following features of which were recorded by the chief engineer of the Roman Stone Co.[9], artificial stone was manufactured by casting concrete in a sand mould, just as molten iron is cast in such a mould. The absorptiveness of the mould was an important factor in the quality of the product obtained from the Stevens process. As soon as the wet concrete was poured into it, water from the concrete was drawn into the sand. The concrete, accordingly, was compacted, but there remained sufficient water in it to hydrate the cement, and the moist sand surrounding the concrete provided it with ideal curing conditions. The process, therefore, applied to concrete manufacture two conditions that only much later became generally recognized as essential for the production of good quality concrete: a low water cement ratio and moist curing.

Although sand moulds were more expensive than the usual wooden or iron moulds, because a separate one was required for each piece cast, the Stevens process yielded a much finer product than could be obtained from other moulds. It was denser, more uniform in colour, and it possessed a

more natural texture than the artificial stone formed in other moulds. The cast article was sometimes left with its as-moulded finish, since a natural stone texture could be obtained by veneering the pattern with thin strips of wood, but it was frequently further finished by hand carving to enhance the detailing.

Quality Control

In making Roman Stone, the quality of the aggregate was carefully controlled, as was its proportioning with cement and water. Various natural stones provided a variety of colours. Thus, for white stone, Niagara limestone and a white marble from Tweed were used; whereas to produce stones of other colours, gray, brown, red and olive sandstones were selected. Each type of stone was dried, crushed and sieved into three particle-size fractions, the largest particles being about corn-kernel size. These fractions were recombined in the concrete mix in proportions that produced a dense material.

The proportioning of the cement and aggregate was closely controlled, as well as the gauging of the amount of water, which was drawn from a tank maintained at constant temperature. The materials were mixed in a mechanical mixer, after which the concrete was run off into large tubs carried by a travelling crane to transport it to the casting shop. The tubs were fitted with spiral paddles to agitate the concrete, thus maintaining a uniform mix until it was poured into the moulds. The concrete was kept in the moulds for three or four days before they were opened, and the casts were then stored in a temperature-constant room for seasoning until shipped.

One-piece stones as long as 20 feet were manufactured, and stones were cast with setting hooks in place. Those that would be subjected to tensile stress in use were reinforced with steel. The products of the Roman Stone Company were nevertheless considered to be relatively cheap, since it was claimed that a column in Roman Stone cost only slightly more than one of wood.

The crushing strength of Roman Stone, depending on the aggregate and the mix proportions, was between 2000 and 4000 pounds per square inch at six months, and in excess of 7000 pounds at two years. Its strength was slightly greater than that of Ohio sandstone and was much greater than that of Indiana limestone. Its strength also greatly exceeded that of concrete made by the dry process, used in the manufacture of certain concrete blocks. The water absorption of Roman Stone, less than 1 per cent, was exceeded by that of Ohio sandstone and Indiana limestone, at 5 per cent each, and was greatly exceeded by that of dry process concrete, in excess of 12 per cent.

Application of Roman Stone

Details of the application of Roman Stone to a particular building project have been recorded in an account of the Imperial Trusts Company

Building on Richmond Street in Toronto.[10] This structure, designed by the architects Chadwick and Beckett and constructed in 1909, now houses the Premier Trust Company (Figure 1). Its entire front was made of Roman Stone, including tall columns, architrave, frieze, cornice and parapet. The moulding of its parts was entrusted to the firm of Adamson and Wicks, who prepared wooden patterns from clay models of the various parts. All the stones of the building were carved after casting to sharpen the arrises and to expose the marble aggregate.

The columns of the building, 4 feet in diameter at the base and over 33 feet high, were formed in 3-foot-high hollow sections with an 18-inch diameter hole to reduce the weight for handling; even so, each of the lower column sections weighed 2½ tons. But the end pieces of the cornice were even heavier, weighing over 3 tons each. The stone of the main architrave, spanning about 20 feet between the two middle columns, was reinforced with a steel I-beam cast within it.

The Roman Stone of this building was made from Tweed marble and Dyckerhoff cement in proportions of about 3½:1. The cement, of German manufacture, cost twice as much as local cement, but was used because of the excellent and uniform product it yielded.

The present building differs in several respects from the original. For example, a parapet, partly wall and balustrade, has been removed from over the cornice. The original entrance, framed in massive and ornate Roman Stone, has also been removed, with entry now gained through a modern addition built alongside the original building. A third change is the replacement of the original windows, which had been topped with semi-circular stone arches.

Other Examples of Roman Stone

Many buildings of Roman Stone have been mentioned in accounts of Canadian building. The Ivey Warehouse on Wellington Street, Toronto, in surviving the great fire of 1904 though surrounded by buildings that perished, was cited as an example of Roman Stone's fireproof qualities.[11] A good example of Roman Stone cast into highly decorative classical architectural forms was the Carnegie Public Library in St. Catharines (Figure 2), described as having been built entirely of Roman Stone[9]. Constructed in 1903, it was demolished in 1965. Demolition was the fate also of the Canada Permanent Mortgage Corporation building (Figure 3) constructed in 1905 in Regina, Saskatchewan; an early example of reinforced concrete frame construction, it was faced with Roman Stone, with a backing of terracotta[12].

Other applications of Roman Stone include the Screen House of the Ontario Power Company plant at Niagara Falls and the Canadian Bank of Commerce building in London[12]. It was employed by architect G.M. Miller to trim the brickwork of the Central Methodist Church, Bloor Street,

Fig. 1(a) Imperial Trusts Company Building (now Premier Trust Company), constructed in 1909; later addition on right.

Fig. 1(b) Detail of column cap, Imperial Trusts Company Building.

Fig. 2 Carnegie Public Library, St. Catharines, Ontario: constructed in 1903, demolished in 1965 (from a colour slide by M.E. Smith).

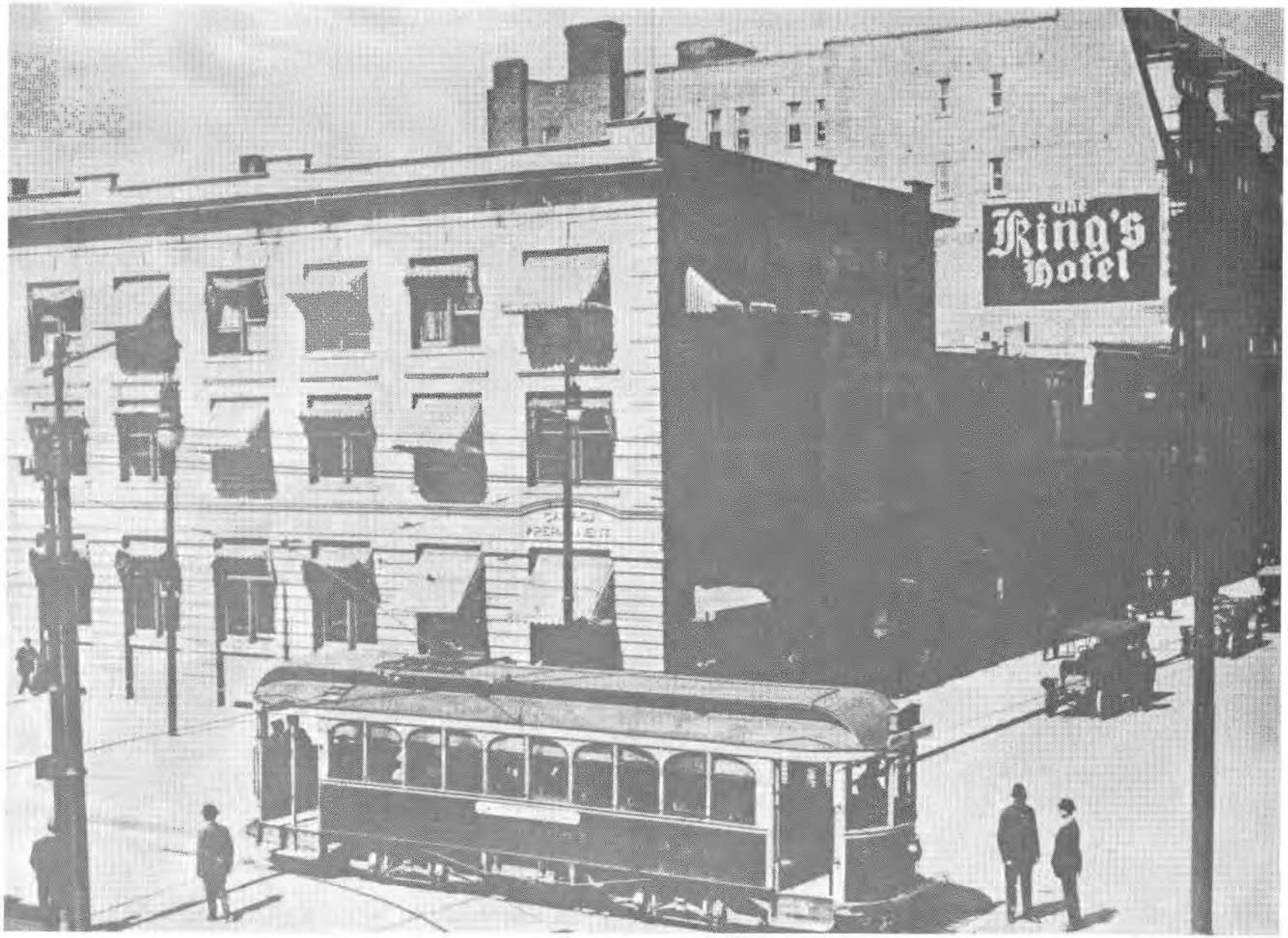

Fig. 3 Canada Permanent Mortgage Corporation Building, Regina, Saskatchewan, constructed in 1905 (Photo courtesy of the Archives of Saskatchewan).

Fig. 4 Graphic Arts Building, Toronto.

Toronto[13], and was used in two other buildings constructed in 1903, a branch bank of the Canadian Bank of Commerce in Parkdale, Toronto, designed by Darling and Pearson, and in the Westmount, Montreal, Branch of the Royal Bank, designed by H.C. Stone[14].

Three notable examples of the use of Roman Stone in Toronto, described and pictured in a 1916 issue of *Concrete* magazine[14], include the Graphic Arts Building (Figure 4) at Richmond and Sheppard Streets, housing the publishers of *Saturday Night* and *Grip* magazines. The balustrade over the cornice now lacks its balusters, probably failed from weathering; this has also cracked balusters elsewhere in the building. A second example, St. Paul's Church (Figure 5) on Bloor St. E., designed by E.J. Lennox and opened in 1913, has Roman Stone as a trim for the exterior stone masonry as well as for interior use. An architectural feature of the building is a rose window 27 feet in diameter of Roman Stone tracery. The third example, the ten-storey steel-frame Lumsden Building (Figure 6) at Yonge and Adelaide Streets, designed by J.A. Mackenzie and constructed in 1909[16], illustrates the use of Roman Stone in early high-rise construction. Except for the ground floor where granite was used, its street-facing walls were finished with Roman Stone carried on the steel frame at each floor and backed with hard brick, which was itself lined with porous hollow brick. The other walls were faced in brick.

Although no confirmation has been obtained on the matter, it appears probable that still another application of Roman Stone was contemplated when the president of the Roman Stone Company, millionaire (and later, Sir) Henry M. Pellatt, had plans drawn by E.J. Lennox for his famous residence, the 98-room "Casa Loma," a project that was completed in 1913.

Decline of Roman Stone

The extensive use of Roman Stone in the decade following the start of its manufacture apparently did not continue after the First World War, perhaps as a result of the economic effects of the war. Changes in architectural style, which reduced the demand for highly decorative and elaborate ornamentation, probably affected the market for the products of the Roman Stone Company, as would have the competition from other firms, notably the Canadian Benedict Stone Ltd. of Montreal, manufacturers of Benedict Stone, a product also cast in sand moulds[17]. Many examples of the use of this material during the 1920's are given in *The Contractor*; they include Trinity College School, Port Hope, the Caron and Keefer Buildings in Montreal, and Acadia University, Wolfville, Nova Scotia[18].

Conclusion

Roman Stone provided Canadian architects and builders with a highly decorative artificial stone that was extensively used in the first decade of this century. Of the many buildings in which Roman Stone was employed, at least two have been demolished, whether from obsolescence, "redevelopment," or advanced weathering decay of the material. Another has been

Fig. 5(a) St. Paul's Church, Toronto; the original church of 1860 is on the right.

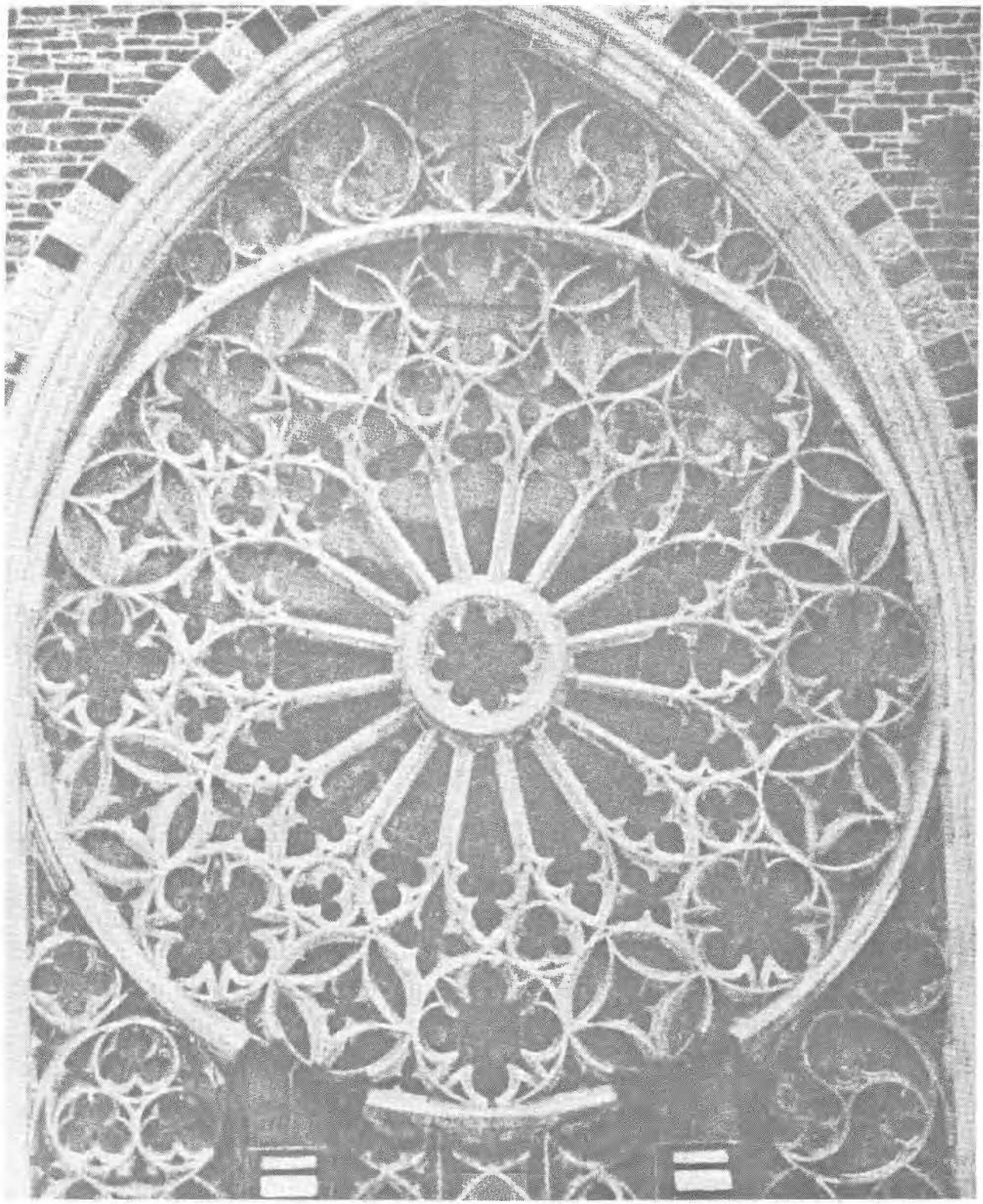

Fig. 5(b) Rose window of the east wall of St. Paul's Church.

Fig. 6 Lumsden Building, Toronto, constructed in 1909. The structure on the right is the Birkbeck Building, constructed from artificial stone made by the Canadian Art Stone Company.

altered from its original design as a result of enlargement and possibly also because of the decay of parts that were freely exposed to the weather.

The buildings of Roman Stone that stand, whether in the original or altered condition, provide examples not only of the early application of decorative artificial stone to Canadian building, but also of an important technical innovation in the manufacture of concrete. In addition, they provide a glimpse of the architectural styles important to Canadian builders and architects of a half-century ago.

Footnotes

1 H.C. Badder, "The invention and early development of Portland Cement," *Concrete*, Vol, 25, No. 4, Oct. 1924.

2 *Patents of Canada from 1824 to 1849*, Lovell and Gibson, Toronto, 1860.

3 *Canada at the Universal Exhibition of 1855*, Toronto, John Lovell, 1856.

4 Patent No. 449, 1854; *Patents of Canada from 1849 to 1855*, Lovell and Gibson, Toronto, 1865.

5 "Experiments on concrete made at McGill University," *Canadian Engineer*, Vol. IV, No. 8, Dec. 1896, p. 221.

6 Willet G. Miller, *Limestones of Ontario*, Report of the Bureau of Mines (Ontario), Vol. XIII, Part II, 1904.

7 Ibid, Part 1 of Report, Statistical Review, p. 14.

8 H.P. Gillette and C.S. Hill, *Concrete construction methods and cost*, New York, Clark Publishing Co., 1908, pp. 644-646.

9 Charles D. Watson, "Decorative cement products," *Canadian Architect and Builder*, Vol. XVII, No. 193, Jan. 1904, pp. 19-21.

10 "Office building of the Imperial Trusts Co," *Canadian Cement and Concrete Review*, Vol. 3, No. 2, Feb. 1909.

11 "The Toronto fire," *Canadian Architect and Builder*, Vol. XVII, No. 197, May 1904.

12 Charles D. Watson, "Report of the Committee on Art and Architecture," National Association of Cement Users, *Proceedings*, Vol. III, 1907.

13 *Canadian Architect and Builder*, June 1906.

14 *Canadian Architect and Builder*, Feb. 1906.

15 *Concrete*, Vol. 9, No. 6, December 1916, pp. 186-188.

16 "The Lumsden Building, Toronto," *Canadian Cement and Concrete Review*, Vol. 3, No. 12, Dec. 1909.

17 J. Clark Reilly, "An interesting cement product," *The Contractor*, Vol. 4, No. 12, Dec. 1924.

18 *The Contractor*, Vol. 4, No. 6, June 1924, p. 35.