Muddy shore to modern port: redimensioning the Montréal waterfront time-space

JASON GILLILAND
Department of Geography, The University of Western Ontario, London, Ontario N6A5C2, Canada (e-mail: jgillila@uwo.ca)

For Montréal in the nineteenth century, as for most port cities, the waterfront served as the primary interface between the city and the markets of the world. This paper examines how and why the primitive waterfront of Montréal as of 1830 was repeatedly adapted and transformed into a modern port district by 1914. Beyond a detailed examination of the set of physical changes on the waterfront, this paper draws theoretical insights from geographical interpretations of the rhythm of capital accumulation to explore the formative and adaptive processes underlying waterfront redevelopment. Global innovations in transport and cargo-handling technology are recognised as the preconditions for the periodic redimensioning of the port of Montréal, and it is established that these changes were driven by the perennial demands of local investors to accelerate circulation and thus reduce the turnover time of capital. This paper offers a new perspective on waterfront development by conceptualising the entire port as a comprehensive circulatory system and then exploring the redevelopment of various components in relation to others. The findings indicate that massive increases in traffic—the number and size of ships—through the port were correlated with the redimensioning of all of the connected components of the circulatory system; that is, the major arteries such as the St Lawrence River ship channel, as well as the smaller capillaries like finger piers.

À Montréal au dix-neuvième siècle, comme dans la plupart des villes portuaires, le havre a servi de principal interface entre la ville et les marchés du monde. Cet article examine comment et pourquoi entre les années 1830 et 1914, le havre primitif a été à plusieurs reprises adapté et graduellement transformé en zone portuaire moderne. Au-delà d'un examen détaillé de l'ensemble de changements physiques affectant le port lui-même, cet article tire des conclusions théoriques de l'interprétation géographique du rythme de l'accumulation du capital dans son rapport aux processus de formation et d'adaptation qui soutendent l'évolution du port. Des innovations généralisées dans le transport et la technologie de traitement du fret sont d'abord identifiées comme conditions préalables pour le re-dimensionnement périodique du port de Montréal. Cet article soutient ensuite que les transformations physiques ont été induites par la volonté sans cesse renouvelée des investisseurs locaux d'accélérer la vitesse de capitalisation et d'écourter ainsi le cycle de la plus-value. Cet article offre une nouvelle perspective sur le développement du port en conceptualisant ce dernier comme système circulatoire intégré et en explorant le redéveloppement de ses divers composants les uns par rapport aux autres. Les résultats indiquent que les augmentations massives du trafic maritime – tant en termes de nombre de navires que de tonnage

The Canadian Geographer / Le Géographe canadien 48, no 4 (2004) 448–472

– sont corrélées avec le re-dimensionnement des composants du système circulatoire; telle l'artère principale que constitue le chenal du fleuve Saint-Laurent et les éléments capillaires plus petits telles les jetées.

Introduction

In Montréal, as in most port cities, the waterfront has long been the primary interface between the city and the markets of the world. Over the last two centuries or so, since the onset of industrialisation, cityports across the globe have been compelled, over and over again, to redevelop their waterfronts. The focus in this paper is on the (re)development of the port of Montréal from its formal beginnings in 1830, through a period of rapid industrialisation up to World War I (1914). The purpose was to elucidate how and why the primitive pre-industrial waterfront was repeatedly adapted and transformed into a 'modern' port district.

A port is a place where land and water-borne transport systems converge, where cargo and passenger traffic are exchanged across a waterfront (Figure 1). The efficiency of a port, and the health of the urban economy as a whole, is represented by its ability to maximise traffic through this physical

Figure 1
The port-city interface, as seen from the Canadian Pacific Railway elevator circa 1890.
SOURCE: Notman Collection, McCord Museum

space at minimum cost and with minimum delay. The waterfront, therefore, is at once both an interface and an impediment to exchange; its physical configuration may contribute to the efficiency of the port or may form costly spatio-temporal barriers. It has been suggested that the flow of goods and people through a city, like the circulation of blood in the human body, is channelled and constrained by the physical dimensions of its 'vascular system', that is, the entire network of streets, canals, channels, harbours, tracks, piers, bridges and elevators (Gilliland 1999). In this paper, I argue that for cities to survive and grow, they must, again and again, accelerate circulation and expand the capacity of the urban vascular system; in particular, they must periodically redimension the entire waterfront time-space. While previous studies have described the historical development of individual physical components of the port of Montréal, such as the Lachine Canal (Desloges and Gelly 2002), St Lawrence River ship channel (Corley 1967) and grain elevators (GRHPM 1981), this paper offers a new perspective on port development in that it considers the entire port as a comprehensive circulatory system and examines the (re)development of various components in relation to others.

Beyond a detailed examination of the physical transformation, or morphogenesis, of the waterfront, this paper attempts to elucidate the formative and adaptive processes underlying its evolution. To understand the processes that continually reshape the landscape of the port, we need to turn our attention to the compelling logic of the urban economy—that is, the revolutionary historical and geographical dynamics of capitalism. Prevailing studies in transport geography view the contemporary redevelopment of cityports across the globe as the spatial outcome of processes of economic restructuring, symptoms of the ever-increasing globalisation of maritime transport (Slack 1975, 1995, 1999; Hoyle and Pinder 1981; Hoyle *et al.* 1988; Kilian and Dodson 1995, 1996; Malone 1996; Meyer 1999; Rodrigue 1999; Slack *et al.* 2002). Drawing insights from 'spatialised' interpretations of the rhythm of capital accumulation (Harvey 1985, 1989, 2001; Smith 1990), I formulate a complementary conceptual approach that recognises the circulation of capital as the driving force behind the morphogenesis of the Montréal waterfront. My central thesis is that periodic innovations in transport methods were preconditions for the redimensioning of the Montréal waterfront in the industrial era, and these changes were adopted in response to the perennial demands of local investors to reduce the turnover time of capital. The turnover time (or time necessary to reconstitute the value) of a given capital is equal to the time devoted to production and circulation (exchange) of commodities. The longer the turnover time of a capital, the smaller its surplus value; therefore, by accelerating circulation through more efficient and effective means of transport, investors are able to increase profits.

The primary data for this study were drawn from the annual reports of the Montreal Harbour Commission, the institution responsible for developing the waterfront and regulating port traffic during the period under study. Available since 1830, these comprehensive ledgers are the most authoritative source of information on port activities during the industrial era. Furthermore, the Harbour Commission reports are an important source of data on the historical geography of Canada which has largely been untapped by researchers (Brouillard 1979). Although this study concentrates on Montréal, similar stories could be (and have been) told for other port cities. Indeed, studies of the historical redevelopment of the New York/New Jersey waterfront reveal processes and patterns similar to those in Montréal, particularly with respect to the nature and timing (if not scale) of the redimensioning of major arteries such as the canals (McIlwraith 1976; Sheriff 1996) and railways (Condit 1980; Doig 2001). In the Canadian context, the Toronto waterfront has undoubtedly received the most scholarly attention, presumably because the redevelopment process and associated conflicts among waterfront land uses have remained extremely contentious public issues to this day (McIlwraith 1991; Goldrick and Merrens 1996; Greenberg 1996; Goheen 2000). Although each cityport develops a distinctive set of functions and features according to its particular historical, geographical, economic and political circumstances, Hoyle (1988, 4) reminds us that 'any individual cityport nevertheless represents to a greater or lesser extent the overall trends that characterise all such locations and which reflect global rather than local factors'. The findings of this paper, therefore, have a much broader relevance beyond Montréal. Furthermore, it is believed that the conceptual framework set out in the following section can help contribute to our understanding of the redimensioning process in other waterfront spaces, over different time periods.

After an exploration of the processes underlying waterfront (re)development, this paper continues with an examination of the agents of change in Montréal. I then explore the role of port labour and transport innovations in accelerating circulation before turning to a detailed examination of the physical transformation of the Montréal waterfront.

Conceptualising Waterfront (Re)development

Its privileged geographical setting was a fundamental reason for the original establishment by the French of a port at Montréal in 1642, and it has been widely suggested, by early civic promoters and economic historians alike, that one only need to 'glance at the map to appreciate the secret of Montreal's commercial pre-eminence' (Chambers 1903, 83; Leacock 1963; Creighton 1970). Indeed, Montréal was closer to European ports than any of its major competitors: 2,760 nautical miles to Liverpool, compared to 2,861 from Boston, 3,043 from New York and 3,335 from Baltimore. Nevertheless, as Marx argued, 'the important thing is not the market's distance in space, but the speed ... with which it can be reached' (1973, 538). The Montréal waterfront was naturally frozen over for five months of the year, a serious disadvantage compared to the ice-free ports of the United States. Furthermore, until the early nineteenth century, few oceangoing vessels even attempted to sail up the St Lawrence River as far as Montréal because of the delays caused by the opposing current and the shallowness of the harbour and its approaches. When Hugh Allan, the future millionaire and owner of the Montreal Ocean Steamship Company, landed in the port in 1826 at age 16, the 300-ton, family-owned brig called *Favourite* required the aid of a steam tug, as well as ten oxen and fifty men pulling from shore. There were no docks or piers as in the Clyde River ports of his native Scotland, so the ship was anchored uneasily with its bilge against the muddy river bank, and the crew skidded the cargo, one piece at a time, down a crude wooden gangway to the beach, where carters waited with their wagons backed up to the axles in water to haul the goods into the city.[1] Evidently, the primitive harbour and approaches experienced by Allan on his first visit to Montréal constituted a significant barrier to circulation; the undeveloped urban vascular system seriously constrained exchange between the city and outside markets. We therefore require more than a mere 'glance at the map' to explain the economic success of the port of Montreal.

During the latter half of the nineteenth century, Montréal underwent rapid industrialisation and development, experiencing massive surges of investment, immigration and construction roughly parallel with other East Coast port cities in North America (Figure 2), and the expansions of capital, it is argued, produced similar trends in urban morphology (Hanna 1986, on Montréal; Olson 1997, on Baltimore). Waves of immigration from overseas and a steady flow of migrants from the countryside facilitated a doubling of Montréal's population every twenty years (from about 23,000 inhabitants

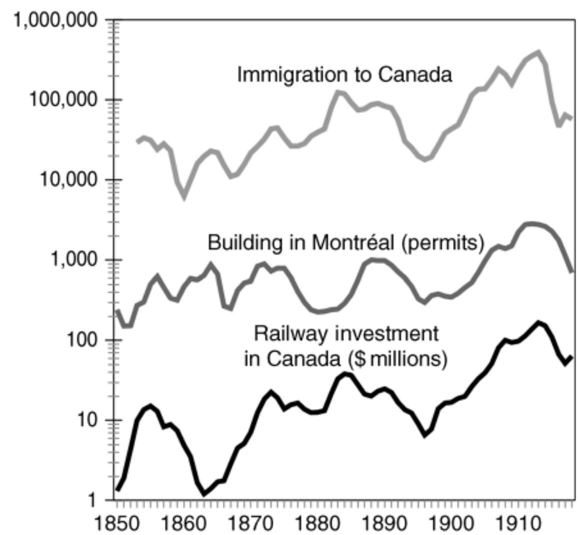

Figure 2
Montréal grew in boom and bust fashion.
SOURCES: Montréal, *Report of the Inspector of Buildings* (1864–1901); Urquhart and Buckley (1965)

1 This narrative was created using details of Allan's life provided in Appleton (1974) and general descriptions of the port at this time (Talbot 1826; Bosworth 1839). The tonnage of a ship is the cubic capacity of the permanently enclosed space (i.e. hull, superstructure and deckhouses) calculated on the basis of hundred cubic feet being equal to one gross ton (Bonsor 1975).

in 1825 to 49,000 by 1850, 107,000 by 1871, 217,000 by 1891 and 468,000 by 1911). The cyclical nature of the accumulation of capital in the built environment has been well described (Harvey 1985; Berry 1991) and is apparent in Montréal (Figure 2). Swings of fifteen to twenty-five years duration, known as Kuznets cycles, are usually indicated by housing or construction permits, but other forms of built capital (e.g., churches, sewers and transport infrastructure) also display the rhythm in response to availability of financing (Harvey 1985; Whitehand 1987; Olson 1997). Consistent with evidence for Montréal, Isard's (1942a, 1942b) analysis of urban development in the U.S. identified a 'transport-building cycle', whereby waves of investment in the built environment were synchronised with investments in transportation, such as canals and railways. Isard argued that the underlying causal forces for the cyclical rhythm of city building were the irregular emergence of innovations in transport and the corresponding jerky development of transport infrastructure.

Economist Schumpeter (1950) coined the term creative destruction to describe the revolutionising processes within capitalism, the incessant cycles of inventing new products and methods of production and destroying old ones. In reference to the built environment (including transport infrastructure), creative destruction takes on a literal meaning: old constructs are periodically demolished to make way for new ones (Gilliland 2002). With respect to the waterfront of Montréal, each surge of investment brought new technologies and structures, which made older methods and facilities obsolete. The entire port area had to be periodically re-created to handle larger and faster ships and trains, to move a larger volume of goods in and out of the city: channels and canals were widened and deepened, piers were added and lengthened, elevators and warehouses were built and rebuilt to carry heavier loads, rail-lines were introduced and augmented in parallel. Each round of creative destruction intensified circulation, raised the city's metabolism and increased the effectiveness of connections between the port and the rest of the city, the city and its hinterland, the city and the world economy. The key to these changes, I argue, was the shortening of the turnover time of capital by a reorganisation of the channels of circulation; in other words, the redimensioning of the waterfront time-space.

Owing to the intense pressures of market competition, investors must continually expand the basis for profit and reduce the turnover time of capital by repeatedly reaching out to new markets, lowering the costs of production and speeding up the physical movement of commodities. With respect to a port, this means periodically finding ways to increase the throughput of traffic at minimum cost and with minimum delay. One of the most powerful ways to increase throughput, lower costs and reduce turnover time is to intensify the exploitation of labour (to lower wages, for example, or to increase the length of the work day). This is especially effective in the transportation and construction sectors, because they are so labour intensive. Such a profitable strategy naturally meets resistance, but the transport-building cycle is closely associated with periods of in-migration (Figure 2), which expands the supply of vulnerable low-wage workers. The greater the labour surplus and the more rapid its rate of expansion, the easier it is for investors to exploit their work force, and conversely, worker resistance is likely to be more powerful during periods of low in-migration (Mandel 1975).

An alternative method of enhancing circulation and reducing the turnover time of capital is to introduce new technology. As Isard recognised, each new cycle of growth is associated with faster and more powerful ships, locomotives and machinery, which, in Marx's vocabulary, works 'to tear down every spatial barrier to intercourse', and to 'annihilate this space with time' (Marx 1973). The reduction in travel time, or 'time-space convergence', generated by transport improvements serves to open up new markets and draw the port city further and further into a more global economy (Janelle 1968). Each new cycle of accumulation not only begins at a higher level of technology, but with fixed capital (e.g., buildings, infrastructure and machines) typically forming a greater part of the total capital invested (Mandel 1975). On the waterfront, for example, one finds the increased mechanisation of the work process, the introduction of powerful cranes and conveyors which helps reduce the turnover time of capital not only by speeding up the loading and unloading of ships, but also by undercutting the bargaining power of the labourer in the market (Winslow 1998).

Since the circulation of traffic is dependent upon the shape and dimensions of the urban vascular system, there exists a direct relationship between transport innovation and investment in built capital. Use of larger and more powerful ships and trains requires further investment to deepen channels, canals and harbours, to lengthen and heighten piers, to add new railway lines and roads and to expand areas for shunting, hoisting and storing goods (e.g., railway stations, elevators and warehouses). It is important to note that investments in built capital such as transport infrastructure have 'contradictory' tendencies; they are fixed into the landscape and therefore restrict future circulation within a set of constraints specific to a previous era (Harvey 1985, 1989; Smith 1990). One effect of incessant technological innovation is to periodically devalue or destroy past investments and radically transform the urban landscape. One turn-of-the-century civic booster explained: 'To make Montreal the modern, up-to-date city it is, the older town, in the construction and equipment of which public debts had been incurred, had to be demolished' (Chambers 1903, 67). This creative destruction is embedded in the circulation of capital and then repeatedly accelerated, periodically heightening the exhilaration of speed and reinforcing the ideology of progress, and at the same time exacerbating instability and insecurity.

Harvey (1985) argues that periodic surges of investment in built capital are normally a sign of growing 'overaccumulation'—a state in which there exists excess capital in the economy which cannot be invested at the average rate of profit usually expected by the owners of capital. Since surges of investment in built capital are usually synchronised with periods of overaccumulation in the primary circuit of the economy, port improvements, and city building activities in general, tend to occur in waves with steep peaks just before depressions. This also means that investments in built capital (including transport infrastructure) typically lag behind demand (Harvey 1985). This was certainly the case in Montréal (1830–1914), as the Harbour Commissioners admitted:

> The Commissioners have devoted much time and thought to a careful study of the different epochs in the history of the harbour, learning therefrom the fact that in almost every case the schemes or projects for the development of the Harbour adopted at the various steps in its advancement, have been found before completed inadequate, and that further works were necessary to cope with the ever increasing requirements of its commerce (Montreal Harbour Commissioners, *Annual Report*, 1914, 9).

Because of its large-scale and long-lasting nature and tendency to be collectively consumed, the built environment tends to be undercapitalised (Harvey 1989). Individual capitalists are usually disinclined to invest in the urban vascular system to make it more efficient and effective even though such investments have the potential to increase profits by decreasing the turnover time of capital. The flow of capital into port development is therefore necessarily sustained by collective action and state intervention.

The Agents of Port Development

To better understand the dramatic physical developments on the Montréal waterfront, we must consider some of the lead actors. Development is usually portrayed as beneficial to everyone; however, its advantages and disadvantages are, in actuality, unevenly distributed. The term built capital reminds us that all of the piers, bridges, tracks and elevators around the waterfront were created with human labour, literally petrified into stone (and iron, wood, ...) for generations. The built environment of the port therefore reflects the decisions of people who controlled property and deployed the labour of others, with the purpose of raising the values of their property and the stream of profits derived from it. The development of the port of Montréal during the industrial era was orchestrated by local entrepreneurs who were in a position to benefit most directly from an enhanced flow of goods and people through the city: merchants, industrialists, landowners, shippers, customs brokers and financiers. Although they normally competed against each other in business, these propertied elites formed alliances and operated as 'growth coalitions' which collectively manoeuvred public investment in the port towards the end of increasing personal wealth by expanding the local economy, enhancing circulation and increasing the demand for their property (Logan and Molotch 1987).

The most influential growth coalition in Montréal was the Harbour Commission. The Montreal

Harbour Commission, established in 1830, was largely a coalition of the 'river and railway barons' who deployed the commercial, industrial and financial capital of the city (Tulchinsky 1977; Brouillard 1979). Two of the original three commissioners were prominent members of the business community: George Moffatt made his fortune in the fur trade; Jules Quesnel was a successful importer and member of the provincial Legislative Council; and the third, Captain Robert S. Piper, was a member of the Royal Engineers, enlisted for technical support. Over the period 1830–1914, the composition of the Harbour Commission was repeatedly adjusted to reflect the increasing importance of the port of Montréal to the local and national economy. Every twenty years or so, near the height of every economic boom, the Harbour Commission expanded its board. In 1855, the president of the Montreal Board of Trade and the Mayor of Montreal were *ex officio* added to the commission. In 1873, the number of commissioners was increased to nine, of whom five were nominated by the federal government, one appointed by the Board of Trade, one by the Corn Exchange, one by the merchant shippers and the remaining post was left for the mayor. Between 1830 and 1914, the cultural composition of the Harbour Commission basically remained unchanged with about two-thirds of its membership being of British origin (primarily Scotsmen) and one-third French Canadian; thus, the commission was largely a coalition of business elite from the English community of Montréal. The Chambre de Commerce, which represented commercial interests in the French community, did not secure representation on the commission until 1893, almost four decades later than its Anglo counterpart the Board of Trade. In 1894, the government appointed a sixth representative on the commission for a new total of eleven members. As of 1907, the federal government took exclusive control and replaced the eleven Harbour Commissioners with three political appointees, which were replaced again in 1911 when Laurier's Liberal regime fell to the Conservatives. The Montreal Harbour Commission was replaced altogether in 1936, when the National Harbours Board at Ottawa was given centralised control of all major ports in the national system.

To further consider the form and character of the growth coalitions driving port development in Montréal, let us take a closer look at the activities and allegiances of two key players Honourable John Young and Sir Hugh Allan. Perhaps, the most influential agent of port development in Montreal was entrepreneur and politician Honourable John Young (1811–1878). Young began his career in transportation in the early 1830s while working for the Torrances, operators of a wholesaling firm and one of the earliest steamboat businesses on the St Lawrence. Young earned his personal fortune in forwarding and land speculation, but eventually lost it due to failed railway and telegraph ventures. In 1846, Young, an ardent liberal, established the Free Trade Association in Montreal with several other leading merchants who advocated the removal of all restrictions on Canadian trade. Like other members of the business elite in Montréal, Young viewed government as an instrument for economic development, an agent for progress and for ensuring a favourable environment for commerce (Tulchinsky and Young 2000). During his twenty-five-year tenure (1853–1878) on the Montreal Harbour Commission, Young initiated the construction of the Victoria Bridge across the St Lawrence and worked incessantly to secure the government capital necessary for dredging the St Lawrence ship channel and expanding wharf space (Montreal Harbour Commissioners, *Annual Reports*, 1853–1878; Young 1876). Young was also a spirited supporter of canal and railway building. Nevertheless, as a supporter of free trade with the United States, he vehemently opposed shipping and railway subsidies to 'protectionist' opponents such as Conservative businessman Hugh Allan. As Tulchinsky and Young (2000) assert, his attitude to port development seems to have mixed public good and personal gain. He sold land and buildings to the Harbour Commission for their offices, and he continuously urged expansion of the port towards the east end of Montreal, where he owned land. Regardless of any personal motives, 'through his foresight', reads the waterfront monument erected in his honour in 1908, 'Montreal has become the national port of Canada'. The Young monument now proudly stands in front of the Allan Building on rue de la Commune (formerly Commissioners Street) in Vieux-Montreal. This placement is symbolic not only because it overlooks his accomplishments in the Old Port, but also because during Young's reign as Harbour Commission president he often stood in Hugh Allan's way.

By the 1870s, Hugh Allan, the boy who had arrived on his father's vessel the *Favourite*, was 'Sir Hugh', owner and president of the Montreal Ocean Steamship Company (1854–1917), and undeniably the biggest of the 'river and railway barons' in Canada. Hugh began his career in the transport industry in 1826—fresh off the boat—as a clerk for a forwarding company. By 1835, he had made partner in the forwarding company—Millar, Edmonstone & Company—which would become H. and A. Allan Company (co-owned with his younger brother Andrew). Slack (1988, 125) has shown that 'many of Canada's future leading capitalists cut their teeth on forwarding', the most visible of the port service industries in Montréal during the industrial era. Work in a forwarding company meant daily contact with other branches of the industry—commission merchants, custom agents, shipping agencies and shipping companies—which in turn provided knowledge and contacts, formal and informal business ties which were vital to success in the transport industry (Slack 1988). As was the case with John Young and several other early players in the shipping industry, Hugh Allan entered the business with modest capital resources, but nevertheless achieved great financial success because of excellent commercial knowledge and strategic affiliations. Not only was Sir Hugh a long-time president of the Board of Trade, but he also sat on the board of many of the leading transport companies and financial institutions in the country (Table 1). Allan used these connections to build his Montreal Ocean Steamship Company into the largest and most influential shipping interest in Canada during the industrial era. In 1892, for example, the Allan's owned more ships entering the port of Montréal than any other company (eighty-four of 735) and shipped the greatest quantity of goods (total tonnage of 203,953 of 1,036,707) (Montreal Harbour Commissioners, *Annual Report*, 1892). Allan's transatlantic trade included immigrants, manufactured goods and natural resources, but the cargo that helped secure his future as shipping magnate was the Royal Mail. Allan first made a bid for the contract in the early 1850s, but was blocked by a coalition of competing capitalists, as well as Harbour Commissioner John Young (Young 1877). In 1856, with the backing of a coalition of Conservative politicians that included George-Étienne Cartier, Allan landed the contract and its £24,000 subsidy (approximately $96,000) to provide regular fortnightly steamship service between Montréal and Liverpool. By 1859, the service ran on a weekly basis and Allan reported his capital investment in the company at £3,500,000 (Appleton 1974; Young and Tulchinsky 2000). Since his incredible success depended heavily on improvements to the port and its approaches, as well as extravagant government subsidies and contracts, Allan was always a generous ally of Conservative politicians. According to Young and Tulchinsky (2000, 11), 'campaign contributions were only one means of manipulating politicians: George-Étienne Cartier's constituents needed jobs in Allan's proposed railway shops, Francis Hincks's son wanted a position in the bank and politicians sailed on Allan's ships and danced at his parties'. Although Sir Hugh was never a Montreal Harbour Commissioner, his interests were nevertheless looked after by his understudy and business partner Andrew Allan, who held the position as representative of shipping interests for over three decades (1873–1906).

Every branch of port industry benefited directly or indirectly from increased port traffic, and therefore, from port improvements. In a constant quest for profits, local growth coalitions attempted, with considerable success, to obtain inputs—great dollops of capital—from colonial and military governments, then from the provincial purse and later from the Dominion or federal government for port improvements (Linteau 1992). In this regard, the growth coalitions of Montréal successfully competed with those in other Canadian port cities, such as Halifax, Québec, Toronto and Hamilton.[2] The activities of Young and Allan reveal the sort of competition that exists at a more local level among entrepreneurs. The two members of opposing political coalitions fiercely competed over control of public subsidies and contracts. Despite their differences, Young and Allan both maintained the common goal of increasing the throughput of port traffic to expand the local economy and thus increase their own individual wealth. In this respect, growth-oriented entrepreneurs were also united in their efforts to control labour. Having introduced the 'big fish' on the waterfront, I now

2 The politics surrounding railway and port investments in Montréal are beyond the scope of this paper and have been considered elsewhere (Easterbrook and Aitken 1958; Creighton 1970; Young 1972, 1978; Tulchinsky 1977; Brouillard 1979).

Table 1
Business activities* of Sir Hugh Allan (1810–1882)

Knighted (1871)
Public offices
Board of Trade President (1851–1882)
Transport sector
Millar & Company Forwarders (1835)
Montreal Great Northern Railway (1847)
Champlain & St Lawrence Railway (1847)
St Gabriel Lock Company (1850)
Montreal Telegraph Company (1852)
Montreal Ocean Steamship Company (1854)
Montreal Railway Terminus Company (1861)
Northern Colonisation Railway (1871)
Canadian Railway Station Company (1871)
Canadian Railway Equipment Company (1872)
Montreal and Champlain Railroad (1872)
Canadian Pacific Railway (1872)
St Lawrence International Bridge Company (1875)
Richelieu & Ontario Navigation Company (1876)
Ontario Car Company (1882)
Canadian Navigation Company
Lake Memphremagog Navigation Company
Troy Telegraph Company
Western Union Telegraph Company
Financial sector
Bank of Montreal (1849)
Marine Mutual Assurance Company of Montreal (1851)
City Bank (1856)
Merchants Bank (1861)
Citizens Insurance and Investment Company (1864)
Canada Marine Insurance Company (1868)
Montreal Credit Company (1871)
Provincial Permanent Building Society (1871)
Canada Life Assurance Company (1872)
Citizens Insurance Company of Canada (1876)
St Lawrence Marine Insurance Company of Canada (1882)
Other business ventures
Acadian Coal Company (1865)
Canada Rolling Stock (1870)
Montreal Warehousing Company (1870)
Canada Cotton Manufacturing Company (1872)
Vale Coal, Iron and Manufacturing Company (1873)
Canadian Rubber Company of Montreal (1882)
Adams Tobacco Company (1882)
Montreal and Western Land Company (1882)
North-West Cattle Company (1882)
Thunder Bay Silver Mining Company (1882)
Canada & Newfoundland Sealing & Fishing Company (1882)
Montreal Rolling Mills
Mulgrave Gold Mining Company
Vermont & Canada Marble Company
Cornwall Woollen Manufacturing Company
Canada Paper Company

*Companies for which Allan was president or director.
SOURCES: Montreal Board of Trade (1893); Chambers (1903); Atherton (1914); Appleton (1974); Slack (1988);Young and Tulchinsky (2000)

want to consider some of the ‘small fry’ by examining the role of labour on the waterfront.

The Role of Waterfront Labour

While much is known about the powerful ‘shipping magnates’ and ‘railway barons’ who left their legacies on the ledgers and landscapes of the industrial era for future generations to behold, much less information remains about the lowly labourers who toiled anonymously along the waterfront. The aim was to gain insight into the experience of port workers in Montréal before World War I and to consider their role in the circulatory system. In the industrial era, the transport sector was especially labour intensive; therefore, the efficiency of the port depended heavily on the size, skills, organisation and complicity of its labour force. This was especially true because, as noted by the Harbour Commissioner in 1914, investments in port improvements always lagged behind demand. To lower the cost of production and speed up the rate of circulation, investors therefore periodically intensified the degree to which they exploited labour on the waterfront. Harvey (1989) reminds us that the disciplining of labour power to the purposes of capital accumulation is a process of ‘labour control’. As we shall see, some of the methods used by owners to control and exploit labour included: increasing hours of work; casual hiring practices; restricting wages; limiting trade union power; and increased mechanisation.

One of the most powerful tactics for reducing turnover time was to extend the work day or work week. When the Lachine Canal first opened in 1825, for example, its hours of operation were from 4:00 AM to 8:00 PM (and sunrise to sunset around open and close of season) six days a week; however, in the boom of the 1840s, shipowners pressured for Sunday service. By 1864, the shipowners successfully lobbied to keep the canal open until 2:00 AM Sunday morning (and all day Sunday near close of season), and by 1882 the canal was open day and night seven days a week (Desloges and Gelly 2002). Although the periodic extension of operating hours was a relatively cheap and easy way to relieve traffic bottlenecks compared to the physical redimensioning of the canal, this strategy made life tougher for canal employees, particularly the lock keepers and bridge operators who, day and night, oversaw the passage of every ship through the canal. In 1882, Montréal became the first port in the world to light all its facilities by electricity, thus making it easier for longshoremen to load and unload cargo all night long. Testimony by a veteran stevedore to the Royal Commission on the Relations of Capital and Labour in 1889 reveals that longshoremen had been enduring longer and longer shifts to reduce the time a ship or boxcar remained in port. By the 1880s, the typical workday for a longshoreman lasted from 7:00 AM until midnight and shifts often lasted longer even up to fifty-five consecutive hours near the close of the navigation season.[3] Management of the Allan Line claimed: ‘It is absolutely necessary to work for that length of time then. The men are quite willing to do it; there is no compulsion’;[4] while at least one Allan Line longshoreman said he had been told by a foreman, ‘if he was not man enough’ to continue working after thirty hours, he would not work again for the company.[5] The reality was that dock workers of the era often had little choice but to work these increasingly long hours because they had little job security and they needed all the hours they could get given the low-wage rate (Royal Commission on the Relations of Capital and Labour 1889).

Another common method of lowering the costs of production and circulation was to manipulate the wages of port workers; to claw back portions for mandatory benefits, for example, or to simply cut them. Stevedores working for the Allan Line after 1864 had 1 percent of their pay deducted for compulsory accident insurance with the Citizens’ Insurance and Investment Company, of which, not surprisingly, Hugh Allan was president. As of 1855, part of a Lachine Canal lock keeper’s wages was doled out in fire wood to heat his company-owned hut, and another portion could be held back if he wished to graze cows on adjoining pastures (Desloges and Gelly 2002). Similarly, workers on the rebuilding of the Lachine Canal in the 1840s not only experienced repeated pay cuts, but they received wages in the form of vouchers to be used in the company store. The Royal Com-

3 Testimony of John Brennan, Montréal stevedore, in Royal Commission on the Relations of Capital and Labor (1889, 150–55).

4 Testimony of Captain John Barclay, marine superintendent of the Allan Line Steamship Co., Montréal, in Royal Commission on the Relations of Capital and Labor (1889, 169).

5 Testimony of Patrick J. Dalton, Montréal longshoreman, in Royal Commission on the Relations of Capital and Labor (1889, 182).

mission on the Relations of Capital and Labour brought to light many of the unfair pay practices in the industrial city, and conditions began to improve by the end of the nineteenth century.

Today's unionised dock labour captures a large share of increases in productivity in wages, but in the century before World War I, a perennial squeeze was possible because of surging immigration (Broeze 1991). Each wave of immigration re-created an exceptionally vulnerable work force for low-wage jobs. Well documented are the exploitation of Irish immigrant labour on the canals during the 1820s and 1840s, on railway construction circa 1851, and Italian immigrant labour on the railways, tramways, tunnels and port circa 1893 and 1913 (Ramirez 1991; Way 1997). Dock work typically employed uncontracted labour gangs who were treated as interchangeable and paid as unskilled labourers, and, around the port of Montréal, the work was unstable due to a seven-month season. Whether or not investors could increase the rate of profit depended in part on the degree of resistance displayed by the working class; the greater the labour surplus and the more rapid its rate of expansion, the easier it was to hold down wages. For example, the Lachine Canal workers of the 1840s were extremely vulnerable to pay cuts and usurious practices because a slowdown in canal building in the United States generated a massive migration of (predominantly Irish) workers to the north. An abundance of immigrant labour meant that transport companies could also exploit cultural and linguistic differences to pit workers against each other, as was the case in several other Canadian and U.S. ports during the late-nineteenth and early-twentieth centuries (Morrison 1976; Winslow 1998). While existing knowledge is inadequate to enlighten us about the inter-ethnic dynamics within the labour force of industrialising Montréal, research indicates that ethnic segmentation was induced by the managerial policies of major employers such as the Canadian Pacific Railway (CPR) and the Grand Trunk Railway (GTR) (Hoskins 1989; Ramirez 1991; Lewis 2000). On the other hand, ethnic segmentation was also reinforced by trade union policies that served to increase solidarity among workers.

While waterfront workers were forced to compete with each other when jobs were scarce, they also occasionally joined forces to react against the exploitation by company owners. The history of the port includes a number of important labour strikes, some of which, like the massive twenty-four-day longshoremen's strike in 1881, paralysed circulation in the city and exchange with outside markets (Table 2). During a weeklong carter's strike in 1864, one newspaper reported: 'The business streets have a kind of Sunday appearance. The vessels have had to stop working and the port has a holiday' (*Montreal Witness*, 1 October 1864; quoted in Heap 1977, 384). The carters struck again in 1871, but by this time their bar-

Table 2
Details of dockworker strikes in Montréal before 1900

Year	Duration (days)	Companies involved	Number of strikers	Dispute	Result
1877	8	Allan Line and others	1,000	Protest salary reduction	In favour of companies
1880	1	Dominion and Beaver Lines	100	Demand raise of $.05/hr	Raise given
1880	9	Allan Line	200	Demand raise	Former employees won case
1880	1	Beaver Line	Unknown	Demand raise	Company hired scabs
1881	3	Harbour Commission	Unknown	Demand raise	Work resumed at same salary
1881	24	Nine maritime companies	1,000	Demand raise	Some companies give raise
1882	13	All maritime companies	Unknown	Demand raise	In favour of companies
1886	2	Ogdensburg Coal-towing	Unknown	Demand raise	Company hired scabs
1887	1	City gas company	Unknown	Demand raise	Both parties compromise
1890	13	Coal companies	300–400	Demand raise	In favour of companies
1890	11	Allan Line	100	Protest dismissal	In favour of companies
1895	12	Dominion Coal	800	Protest non-union employees	Return to work without conditions
1895	2	Dominion Coal	8	Refuse to work Saturday night	In favour of company

SOURCE: Hamelin *et al.* (1970)

gaining power had diminished, with railway cars arriving right onto the docks. In strike situations, unskilled workers had little bargaining power. Of the thirteen dockworker strikes known to have transpired over the latter half of the nineteenth century, the companies only capitulated three times (Table 2).

In the course of labour negotiations, company owners usually had the support of all levels of government. Nineteenth-century courts and police treated labour strikes as 'unlawful restraints of trade', and until after the Nine-Hour Movement strikes of 1872, the formation of a labour union was considered an act of criminal conspiracy (Rouillard 1989). In 1843, the protests by Lachine Canal workers against longer work days and unfair pay practices turned into a bloody rebellion after the government called in the army to break the strike. The 1903 strike by more than 2,000 Montréal longshoremen was described in the newspapers as a civil war (Linteau *et al.* 1983). Strikes often failed because of federal and provincial labour legislation, the power of management in the workplace and the deployment of police and strikebreakers. In the interests of trade, governments put an early end to strikes by forcing workers into arbitration. Local troops and militia were used regularly to break up strikes, while railways permitted the rapid entry of private security forces and scabs. To combat the longshoremen's strike of 1903, troops from Toronto were brought in to bolster the Montréal militia, while 1,000 workers were imported by the shipping companies as scab labour from Britain (Morton and Copp 1980).

Empirical evidence for the period 1850–1915 suggests that the tendency for workers to strike was cyclical in nature, peaking during depression periods when the floods of immigrants typically dried up and when the competition of seaports and entrepreneurs was intensified and transferred to press the competition among labourers beyond the limits of their toleration (Hamelin *et al.* 1970; Thwaites 1984). Waterman (1990) argues that transport workers hold a strategic position in the process of capital accumulation because 'transportation is the weak link, representing a dead period between investment and realisation. The dead period for capital accumulation also represents a weak link in the control of labour' (15). By looking at the timing and nature of labour strikes on the waterfront, one gets a glimpse of how transport workers periodically attempted to use their strategic position in the accumulation process to make advances in the perennial class struggle inherent in the capitalist economy.

For company owners, one of the most powerful responses to a temporary loss of control over labour was to periodically crank up the mechanisation of the work process. Throughout the industrial era, increased mechanisation—the addition of powerful cranes, elevators, conveyors or railway cars on the docks—radically altered the cargo-handling process and the role of the dock worker, speeding up the pace of what Pred (1990) has dubbed the 'berthside ballet'. Increased mechanisation also typically resulted in the replacement or de-skilling of part of the workforce. Therefore, investment in new technology and infrastructure helped reduce the turnover time of capital not only by speeding up the loading and unloading of ships, but also by undercutting the bargaining power of the labourer in the market. The following section takes a closer look at the impact of innovations in transport technology on accelerating circulation.

Innovations in Maritime Transport Technology

The introduction of new technology was a highly effective method of reducing the turnover time of capital. Each new wave of investment during the industrial era brought technical changes in marine engineering with respect to propulsion systems, hulls and superstructures, which, taken together, enabled larger ships to travel faster, at lower unit costs, and with greater reliability. To document the impact of the modernisation of shipping with respect to Montréal, I examine changes in the fleet of the Montreal Ocean Steamship Company—also known as the 'Allan Line'—the largest and most influential shipping company associated with the port during the study period.[6] In wooden sailing ships of the 1830s, a journey such as Hugh Allan's first trip from Greenock, Scotland to Montréal took about six weeks and four weeks to return (Appleton 1974). By 1856, the first iron steamships to cross the Atlantic for the Allan Royal Mail Line were making regularly scheduled trips from Montréal to Liverpool in less than two weeks. The first

6 Specifications for all the ships in Allan's fleet between 1854 and 1917 are provided in Bonsor (1975, 278–325).

steamship owned by the Allan's, the *Canadian*, was 277 feet (92 m) long, made of iron and propelled by a single-screw, two-cylinder engine. It had a capacity of 1,764 tons and provided accommodation for eighty first-class passengers and 350 in steerage. Hugh Allan publicly stated that ships of 1,700 tons were the most suitable for the Montréal trade; however, 'year by year the Allan's launched new boats, always bigger and faster' (Atherton 1914, 581).

In the late-1870s, with the renewal of the Royal Mail subsidy at risk, the company invited tenders for a steamship of record-breaking size and speed. Launched in 1881, Allan's vessel, the *Parisian*, with its innovative steel hull, bilge keels, multiple-compound steam engine, superstructure of decks and machinery for handling cargo, defined the image of modernity for contemporaries (Montreal Harbour Commissioners, *Annual Report*, 1881). It had three times the capacity of the 1856 vessel and reduced the travel time from Montréal to Greenock to just ten days, barely one-third the time of the old *Favourite*. It was 440 feet (146 m) long and could accommodate 150 first class, 100 second and 1,000 steerage passengers. It was 'fitted with four double-ended marine boilers supplying steam at seventy pounds per square inch to a three-cylinder compound engine of Gothic proportions' (Appleton 1974, 139). In 1881, for the first time, a greater number of ships arriving in Montréal from overseas were steam powered (321 versus 248 sailing ships). At the same time, the *Parisian* was the largest steel steamship in the world. Nevertheless, it was inevitable that the *Parisian* would be stripped of this distinction before long, and by 1899, it was necessary to modernise the ship and refit it with triple-expansion engines.

As the population of Montréal approximately doubled after every boom period between 1830 and 1914, so did the size of the largest ship in the port. By the end of the century, steamships over 10,000 tons were serving Montréal. Before being put into trooping service in WWI, the *Corsican* (built 1907) was the largest ship serving the North Atlantic routes for the Allan's. Over 500 feet (165 m) long, the 11,419-ton *Corsican* could accommodate 210 first class, 250 second and 1,000 steerage passengers. The launching of the *Corsican* in 1907 signified the end of the sail era, as the tonnage of that one ship was greater than the combined tonnage of all maritime sailing vessels entering the port of Montréal that year (7,042) (Figure 3a).

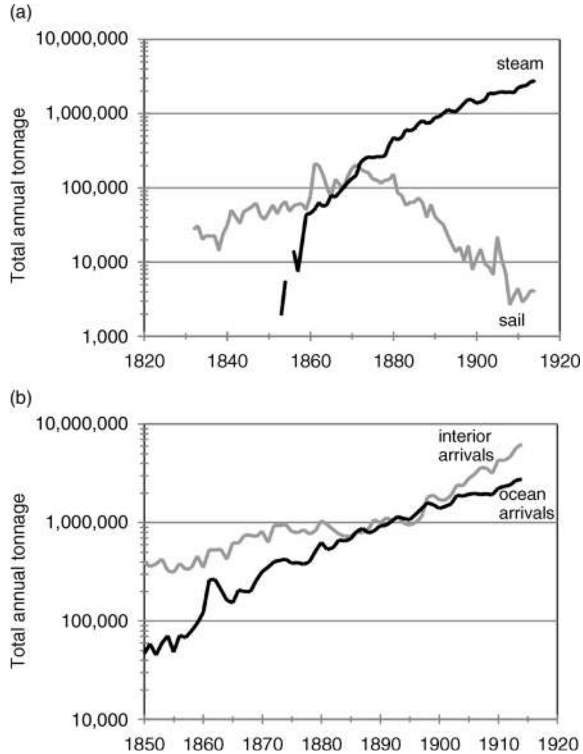

Figure 3
Ship traffic in Port of Montréal: (a) sail versus steam ocean arrivals, 1830–1914; (b) interior versus ocean arrivals, 1850–1914.
SOURCES: Montreal Harbour Commissioners, *Annual Reports* (1830–1914)

The average lifespan of a steamship on the North Atlantic route for the Allan's was only nine years. While many ships were naturally wrecked at sea (e.g., one-quarter of the Allan fleet), the process of creative destruction meant that most ships were likely to be taken out of service before they sank. A ship launched during one economic boom was sure to make its final voyage before the end of the following boom period. When a ship was no longer adequate for the all-important North Atlantic service, it was either removed to another route (21 percent), enlarged or refitted with new equipment (41 percent), sold off to another line (24 percent) or scrapped altogether (14 percent).

Spectacular advances in the size and speed of steamships were associated with massive increases in the flow of trade through the port of Montréal. For example, ocean arrivals totalled less than 28,000 tons in 1832, but grew at a rate of about 6.6 percent per year: doubling by 1850,

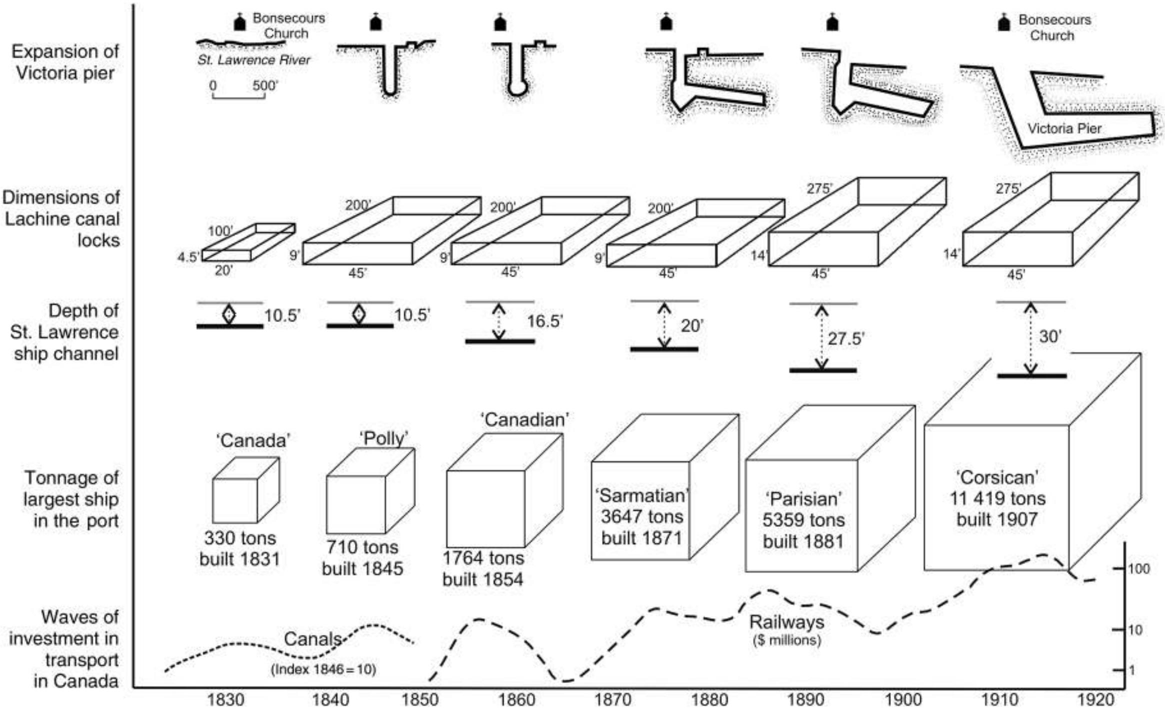

Figure 4
Correlated growth on the Montréal waterfront.
SOURCES: Montreal Harbour Commissioners, *Annual Reports* (1830–1914); Montreal Board of Trade (1893); Atherton (1914); Bonsor (1975); various cartographic sources

growing 100-fold by 1914 (Figure 3b).[7] Montréal's share of the total value of world trade also grew continuously from approximately 0.3 percent in 1850 to 0.6 percent in 1872 to 0.8 percent by 1913 (Montreal Harbour Commissioners, *Annual Reports*, 1850–1914; Imlah 1958). Traffic arriving from the interior of Canada (primarily staples for export) was even greater than that from overseas, increasing from about 400,000 tons in 1850 to 6.3 million by 1914; however, the rate of increase was lower at about 3.9 percent per year (Figure 3).

Figure 4 (bottom) illustrates the tonnage of the largest ship in the port of Montréal at the crest of each wave of investment in the transport-building cycle. Evidence indicates that ship capacity doubled with each successive wave. Only the *Parisian* represented a special case to the trend, as it appeared on the scene just before an economic upswing and it was not quite double the size of its predecessor; however, this ship encompassed a number of important innovations (mentioned above) which presumably helped prolong its reign as the port's pre-eminent ship (and postponed its creative destruction). Since traffic circulates within a well-defined vascular system, we should expect to find that massive increases in the number and size of ships through the port will be correlated with the enlargement, or redimensioning, of all of the connected parts of the system; that is, the smaller capillaries like piers and elevators, as well as the major arteries such as the Lachine Canal and the St Lawrence River ship channel. The proportional growth, or 'allometry', in the system is represented in Figure 4, and the key components are explained in greater detail below.

7 The exponential annual growth in ship traffic is best described with the basic growth equation: $Q_t = Q_0 e^{at}$, where Q is a quantity (e.g. of traffic), t is the time elapsed since time 0 and a is the rate of growth.

Port Morphogenesis: Redimensioning the Urban Vascular System

The first piece of major surgery performed on the traffic arteries was a bypass: the 13.4-km long Lachine Canal, completed in 1825, allowed vessels drawing 4.5 feet (1.5 m) to avoid the Lachine Rapids on the St Lawrence River and connected Montréal to the Great Lakes, thereby further opening up trade with Upper Canada. The project was initiated by a coalition of private entrepreneurs (Company of the Proprietors of the Lachine Canal), but it was eventually taken over and completed by the Province of Lower Canada with a grant of £10,000 from the Imperial Government. Before the opening of the canal, supplies were usually carted over land from the port to the town of Lachine for forwarding upstream by freight canoes (*bateaux*) and Durham boats. The bateau was a flat-bottomed skiff about 12.5 m long, two to three metres wide in the centre and had a capacity of about five tons. The Durham boat was a flat-bottomed barge about 25–30 m long, 3 m across, and had a capacity of up to fifty tons downstream (eastbound), but averaged only about eight tons upstream, due to the rapids (Tombs 1926). At the time of the canal's opening, oceangoing vessels typically drew close to 10 feet (3m); hence, water travel beyond Montréal still involved transshipment. Since nineteenth-century ships navigating the Great Lakes also typically exceeded the dimensions of the canal, Western grain was usually shipped to Kingston and transferred to barges before travelling to Montréal, where it was transferred again to oceangoing vessels. Every episode of transshipment represented a costly delay. The size of the largest vessels on the canal was constrained by the capacity of the locks, which, to compete with the Erie Canal (which was drawing much more traffic from the Canadian West to the Port of New York), was more than quadrupled in the 1840s and then doubled again in the 1870s. The redimensioning of the locks is represented in Figure 4. The canal itself was only 48 feet (16 m) wide with a depth of 4.5 feet (1.5 m) in the 1820s (1821–1825); however, it was enlarged to a width of 120 feet (40 m) and a depth of 9 feet (3 metres) in the 1840s (1842–1848) and again to a depth of 14 feet (4.6 m) in the 1870s (1875–1878). By 1862, the canal was widened so that two vessels could pass safely. In addition, during each episode of redimensioning, the number of locks was reduced, which further diminished the length of time spent on the canal. In 1903, the dimensions of all the canals in the St Lawrence system were standardised to remove the transhipment stop at Kingston. The removal of this bottleneck was necessary to compete with the U.S. for a greater share of the booming Western grain trade.

One of the most simple and cost-effective methods of reducing turnover time on the canal was to simply increase speed limits, which were strictly enforced to prevent accidents. In the early days, canal speed was restricted to 2 km/hour, the average walking speed of a tow horse; however, by the end of the century, canal traffic was dominated by steam-powered vessels that had the capacity (and the economic necessity) to go much faster. Instead of performing another costly physical reconstruction of the canal, the speed limit was repeatedly increased: to 6.4 km/hour in 1895 and to 9.6 km/hour by 1924. When the canal was first opened, the trip from Montréal to Kingston (about 280 km) by bateau or Durham boat took about twelve days; however, by the early decades of the twentieth century, a 2,500-ton bulk carrier (sixty times the capacity of the Durham boat) could make the return trip from Montréal to Chicago (about 4,000 km), fully loaded both ways, in similar time (Montreal Harbour Commissioners, *Annual Reports*, 1830–1880; Keefer 1850; Young 1859; Kingsford 1865; Tombs 1926; Tulchinsky 1960; Creighton 1970; Bergeron *et al.* 1983; Willis 1983; Desloges and Gelly 2002).

While the dimensions of the Lachine Canal restricted ship traffic arriving from the west, the size of the largest oceangoing vessels through the port was constrained by the dimensions of the natural ship channel between Montréal and the sea, which was less than 3.5 m (10.5 feet) in some places. In the first half of the nineteenth century, most oceangoing vessels usually had to discharge at Québec and/or be towed from Québec to Montréal for fear of running aground on the shoals of Lake St Peter, which, as the following account in 1833 suggests, was a fairly regular occurrence: 'The *Richard Watson*, on her way from Montreal to Quebec in tow of the *Voyageur*, got aground in the Lake on Friday forenoon. The *Canadian Eagle*, on her last trip down was aground at Berthier nearly thirty-six hours' (*The Gazette* 14 May 1833; quoted in Corley 1967, 296). Discharging cargo onto several lighter vessels meant costly delays. Between 1850 and World War I, to keep up with the massive increases in the size of ships on the Atlantic, particularly those servicing Liverpool and the Clyde River ports of Scotland (Greenock and Glasgow), the Harbour Commissioners repeatedly dredged the channel, achieving a depth of about 10 m (30 feet) by 1912. All of the work was carried out by the Harbour Commission and financed by tonnage-dues until 1888, when the Dominion Government officially recognised the St Lawrence as 'the national route of Canada' and assumed the debt and further expenses incurred with respect to deepening the channel. Between 1851 and 1888, the total expense (less interest) of deepening the canal had amounted to over $3.4 million (Montreal Harbour Commissioners, *Annual Reports*, 1850–1914; Montreal Harbour Commissioners 1855, 1884; Montreal Board of Trade 1893; also Cowie 1915; Corley 1967).

The allometric relationship diagrammed in Figure 4 is graphed in Figure 5a, and the steep slope of the curve (3.2) indicates that between 1851 and 1914, every 10 percent increase in channel depth was associated with a 32 percent increase in the tonnage of the largest ship entering the port.[8] The percentage increases in ship tonnage appear greater than the increases in channel depth because tonnage is a three-dimensional, rather than a one-dimensional, measure; thus, every increase in the depth (draught) of a ship is usually also associated with increases in overall dimensions (length, width and height) to accommodate a proportionally greater tonnage. Furthermore, periodic improvements in maritime transport technology meant that given the same draught, new ships could carry a greater tonnage than older ships. It is important to recognise that the observed relationship can be stated the opposite way: a 10 percent increase in the size of the largest ship in the port was related to a 2.9 percent increase in the depth of the ship channel. The relationship between channel depth and ship size might be interpreted in two different ways because the direction of causality is not explicit. For example, although it would be incorrect to suggest that increased channel depth will cause larger ships to enter the port of Montréal, it is undeniable that increased channel depth allowed larger ships into the port. On the other hand, I argue that larger ships caused the channel to be deepened: the ship channel was periodically deepened by the Harbour Commissioners to accommodate larger and larger ships on the North Atlantic routes, and ever larger ships were a response to the perennial demands of entrepreneurs to accommodate increased exchange between the port of Montréal and overseas markets. Support for this argument can be gleaned from a letter by Harbour Commission President John Young to Secretary John Glass in 1853:

> Let us recall to mind that the deepening of the ship-channel in Lake St. Peter to 15 feet at low water, was only completed in November, 1852, and yet, what results have we already seen flowing from it?—In the spring of the present year, several vessels made their appearance at our wharves of larger tonnage than were ever employed before in trade with this city . . . and the prospect of a great future increase seems also certain, provided we can only accommodate the large craft which are already in course of construction, and spoken of, for the purpose of trading with Montreal (Montreal Harbour Commissioners, *Annual Report,* 1853, 1).

In other words, the expansion of trade with overseas markets demanded the use of ever larger ships, which, in turn, necessitated the periodic deepening of the passage between Montréal and the Atlantic. Since traffic circulates within the entire vascular system, the arrival of a greater number of increasingly larger (deeper, longer and taller) ships required a redimensioning of several other vital arteries.

The membrane between land and water is also critical; its form limits the scale at which goods can move across it. Here, I focus on the edging of piers. Before 1830, there had been no official attempts to improve the port; there existed only a few 100 feet of privately built wooden docks, which were torn up by the magnificent ice shoves each spring.

8 Equations of allometry or proportional growth are power laws of the general form $Q_1 = bQ_2$. They state the value of one variable Q_1 in terms of another Q_2 raised to some power (b is the value for Q_1 when $Q_2 = 1$). In the logarithmic form, the equation becomes: $\log Q_1 = \log b + \log Q_2$. This allometric equation applies to a diverse range of morphological, physiological, biochemical and phylogenetic data (Bertalanffy 1968; West *et al.* 1997). Using the power equation, the allometric relationship between ship size and channel depth can be stated as: *Tonnage of Largest Ship* = 6.714 (*Metres of Channel Depth*)$^{3.192}$. Alternatively, the relationship can be expressed in the logarithmic form as: log (*Tonnage of Largest Ship*) = 0.827 + 3.192 log (*Metres of Channel Depth*).

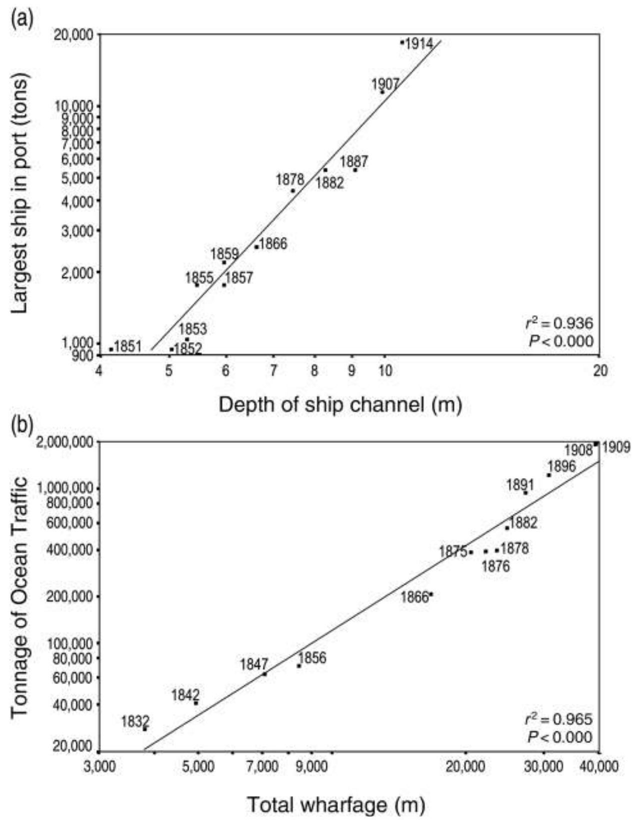

Figure 5
Allometric relationships between traffic flow and port dimensions: (a) relation between depth of ship channel and largest ship in port; the years for which data are available are indicated; (b) relation between total wharfage and total annual tonnage of ships in port; the years for which data are available are indicated.
SOURCES: Montreal Harbour Commissioners, *Annual Reports* (1830–1914); Montreal Board of Trade (1893); Atherton (1935); Hamelin and Roby (1971); Bonsor (1975); GRHPM (1982)

Owing to the increased traffic coming through the new Lachine Canal, it became apparent to local merchants and politicians that permanent wharves were necessary. Between 1830 and 1833, the first Harbour Commissioners, equipped with a harbour redevelopment scheme drafted by Captain Piper and improved by engineer Peter Fleming, ordered the construction of ramps between the beach and Commissioners Street [which was raised to about twenty feet (6.6 m) above water to combat flooding], slips for Durham boats and a wharf that encompassed the old mud flat of Market Island (also known as Île Normand and Oyster Island). These harbour improvements were praised by members of the Montreal Board of Trade and the Chambre de Commerce, who nevertheless argued that much more accommodation for shipping and greater facilities for transhipment were necessary. They argued that delays cost money, and some ships from overseas were being held in port for as long as three weeks before being able to secure a berth for unloading. The Committee on Roads and Improvements, 1841, a coalition of business elite from both the French and the English communities, reasoned: ‘the great expense of such detention and the numerous other impediments to which commerce is at present subject, would far exceed the interest of capital, sufficient to make Montréal one of the most commodious ports on the Continent of America’ (1).

Between 1839 and 1846, the Commissioners planned and undertook further works, including the widening and macadamising of Commissioners Street and the building of four new ‘finger piers’

[Nelson (1839–1840), Wellington (1839–1840), Russel (1845–1846) and Victoria (1845–1846)]. The finger pier was a structural innovation that had a major impact on the morphology of the city-port. By essentially adding usable shoreline, the finger pier accommodated increased activity in the old central core and, therefore, helped postpone the seaward migration of port operations. The finger pier also altered urban relationships by pushing citizens further and further away from the river. The first two piers, Nelson and Wellington, measuring approximately 65 m and 80 m in length respectively, were primitive structures—macadamised, pine-plank platforms supported by pilotis made of oak. Russel and Victoria piers were longer than their predecessors (just over 100 m each) and also more solidly constructed using new techniques of cribwork. The extent of pier developments by 1846 is mapped in Figure 6. Although there were no large-scale pier-building projects carried out between the late-1840s and the mid-1890s, increased ship traffic demanded a tripling of the total length of wharves over the half-century. Most of the expansion of wharf space came, not by transforming the congested central portion of the port, but by developing new wharves downstream of the city.

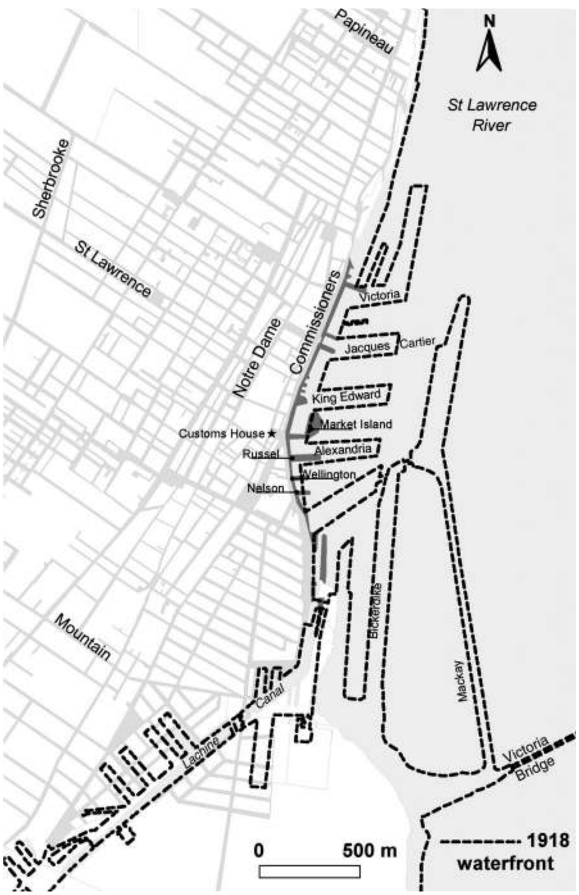

Figure 6
Montréal in 1846 showing port-city interface by 1918 (note: beyond the map limits are new high-level piers northeast of the city centre).
SOURCES: Cane (1846); David (1919)

A global plan for redeveloping the port was prepared in 1877, but work did not begin on the project until almost two decades later due to political squabbles between Conservatives and Liberals at the federal level (Bell *et al.* 1878). An updated version of the plan (from 1893) was eventually approved in 1896 by the new Liberal government and put into action by Minister of Public Works Joseph-Israël Tarte; however, by the time the project got underway, it was already deemed inadequate to handle the increasing demands of trade. The first major improvement of this later period was a long guard pier (Mackay) to protect the harbour during the spring breakup of ice and a large pier parallel to the entrance of the Lachine Canal (Bickerdike). Then followed the new high-level piers near the centre, to replace the obsolete piers of the 1830s and 1840s [Jacques Cartier (1898–1899), Alexandra (1899–1901), King Edward (1901–1902) and an expanded Victoria (1910)]. More than triple the length of their predecessors, these new piers extended almost half a kilometre into the river. Since the ultimate length of the finger pier was restricted by the relative location of the ship channel, the 'hooked finger' redesign of the Victoria Pier represented a creative method of pier expansion. The multiphase evolution of Victoria Pier is illustrated in Figure 4, and the expansion of the port-city interface by 1918 is mapped in Figure 6. Around the same time, three new high-level piers were built further down river (northeast) near the city's border with the city of Maisonneuve: Sutherland, Laurier and Tarte, named after Liberal politicians who supported the project. With all the port improvements being made and jobs being created in the east end of Montréal, Tarte was guaranteed re-election in his east end riding of Sainte-Marie. Another relentless Liberal supporter of these improvements was

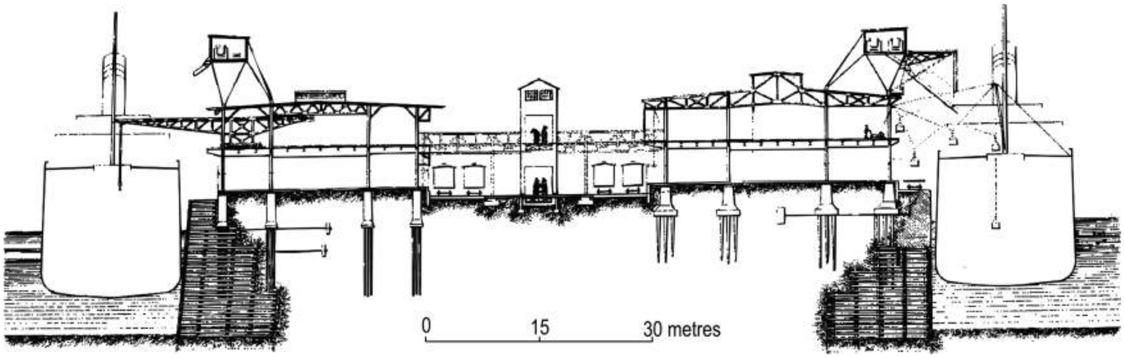

Figure 7
Elevation of typical Port of Montréal pier built after 1890.
SOURCE: redrawn from Cowie (1915)

Honourable Raymond Préfontaine, mayor of Montréal (and thus, member of the Harbour Commission) from 1898 to 1902. In 1902, he left municipal politics to become Minister of Marine and Fisheries in Laurier's cabinet, but through port improvements, he remained true to his promise to his former constituents that he would promote urban development in the east end of Montréal (where he also happened to own considerable land for speculation) (Linteau 1985).

As the population of Montréal approximately doubled after every boom period, so did the total length of wharves in the city (Figure 5b). Data for the period between 1832 and 1909 suggest that an addition of 10 percent more wharf space was associated with an 18 percent increase in total ship tonnage. Again, because the direction of causality is not entirely explicit, it can alternately be stated that a 10 percent increase in the total ship tonnage entering Montréal was accommodated by a 5 percent increase in total length of wharves.[9] In this paper, I argue in support of the latter direction that the perennial increases in ship traffic forced the Harbour Commissioners to continually expand the wharf space available for docking, loading and unloading. The percentage increases for total tonnage appear greater than the increases for total length of wharves because tonnage is a three-dimensional measure, whereas wharf length is one-dimensional. Over time, each linear foot of wharf space was more intensely used because ships became proportionally taller, deeper and bulkier, in relation to their length. Furthermore, technological innovations over the study period meant that ships could be loaded and unloaded more quickly, and increasingly shorter turnaround times meant that each foot of wharf space could accommodate a greater number of ships and greater total tonnage each year.

Not visible on the two-dimensional plan are the technical changes in cargo handling and pier construction which facilitated increased circulation. Again, the breakthrough technology was three-dimensional, as changes in the vertical dimension produced the acceleration. To accommodate larger ships, piers built after 1891 were 28 feet (9.3 m) above water, four times higher than the oldest piers; to handle larger volumes, they contained two-storey steel sheds, equipped with machinery for exchanging cargo between ships and the railcars and horsecarts which ran right through the middle (Figure 7). In his report for 1860, Chief Engineer Robert Forsyth contextualised the benefits of new cargo-handling technology:

> While the Commissioners are endeavouring to extend the present wharfage of the Harbour, I beg to direct their attention to the propriety of affording facilities, for more expeditious and economical means of loading, and discharging cargo, as every aid thus afforded adds to the extent of wharfage, in proportion to the facilities so presented (Montreal Harbour Commissioners, *Annual Report,* 1860, 41).

9 The allometric relationship can be stated as: *Ocean Tonnage* = 0.007 (*Metres of Wharves*)$^{1.813}$, or, in logarithmic form as: log (*Ocean Tonnage*) = −2.171 + 1.813 log (*Metres of Wharves*).

One of the most important 'homegrown' technological innovations the Harbour Commissioners instituted (in 1857) to speed up circulation, the 'floating elevator', essentially reduced the need for piers altogether. When wharf space was unavailable, the steam-operated floating elevator could be piloted out into the middle of the harbour to draw grain from the holds of lake vessels and deposit it simultaneously into ocean-bound freighters without ever touching a pier (Montreal Harbour Commissioners, *Annual Reports,* 1830–1914; Trautwine 1859; Bell *et al.* 1878; Linteau 1972; GRHPM 1982; Hanna 1998).

While steam technology helped break time-space barriers on the sea, the steam locomotive did the same for travel on land. Although the story of railway developments is beyond the scope of this paper (and remains to be written), a few points with respect to the waterfront deserve attention so that it is possible to see the critical zone of interlocking between the two components of the vascular system. In the 1850s, the GTR opened a line to ice-free Portland (Maine), which allowed Montréal merchants to bypass the port of Montréal in winter (November to May), but also served to draw capital south (Montreal General Railway Celebration Committee 1856). This line was made possible after the completion of the nearly two-mile-long, tubular Victoria Bridge in 1859. As the first bridge to cross the St Lawrence, it relieved a serious obstacle to circulation. Its single track was soon perceived as a bottleneck so in 1898 it was re-created as a steel-truss bridge to carry two lines, a road and a footpath (Montreal Harbour Commissioners, *Annual Reports*, 1857–1859, 1897–1898; Lelièvre *et al.* 1999).

The Grand Trunk laid the first rails on the docks in 1871, and the Canadian Pacific followed in 1885. Direct shipside access reduced the need for carters, and therefore greatly reduced costs and turnover time. The attempts of railway corporations to monopolise access to the waterfront have been an obstacle to port development in many cities, including Toronto (Goheen 2000) and Baltimore (Olson 1997). In 1907, the Harbour Commissioners took over management of the tracks to open up equal access to all companies. By this time, there were 28 miles of tracks on the port, which handled about 70,000 boxcars per year; by 1918, the trackage had doubled and the annual volume of rail traffic had tripled (Montreal Harbour Commissioners, *Annual Report,* 1918). Given that a typical boxcar of the time had a capacity of 40 tons (Wright 1912), it is estimated that the harbourfront rail lines carried approximately 280,000 tons of cargo in and out of the port in 1907 and 840,000 tons in 1918. Since each boxcar usually entered and exited the port fully loaded, the actual rail tonnage figures were probably twice as high. Since the tonnage of rail traffic tripled between 1907 and 1918, whereas the total tonnage of ship traffic from the interior only doubled, the evidence indicates that railway lines became more important arteries in the urban vascular system during this period. Indeed, this trend is reflected in the evolving nature of the grain trade, which increasingly relied on the speedier railway instead of the old canal system.

The constant shortage of railway cars, particularly during the seasonal 'grain rush', was a perennial bottleneck in the harbour economy (Cowie 1913). Given the large capital investment represented by a railway's cars and other equipment, companies had a strong incentive for rapid turnaround. In an attempt to solve the car shortage and relieve congestion, railway companies and the Harbour Commissioners introduced automated facilities for storing and handling grain on the port. The first structures for storing grain were built along the canal between 1859 and 1872 by the GTR, through its subsidiary, the Montreal Warehouse Company. These were not true 'elevators', but long, linear, low-lying, wooden sheds. In the 1880s, upon completing transcontinental links to the Prairies, the Canadian Pacific built the first true grain elevators (wooden) on the Montréal waterfront, and the city captured a greater share of the grain trade to Europe. The first two elevators of the CPR, known as 'A' and 'B', were built in 1885 and 1887, and each had a capacity of 800,000 bushels (or about 2,500 boxcar loads). Their massive bulk made them the first structures to challenge the traditional skyline of church steeples. Exempt from the city's ten-storey height restriction (enacted in 1901), the first steel elevators (1902–1906) rose to twelve storeys and were the tallest buildings in Montréal. These elevators had a capacity of 1,000,000 bushels. One elevator was constructed by the port (1902–1904) and the other was constructed by the GTR (1903–1906). These elevators were not merely intricate storage bins, but mechanised grain-handling facilities that operated with gravity flow and steam power. Cronon (1991) suggests that the increasing scale and efficiency of the new technology depended on one thing: moving grain without sacks. Once grain was out of the sack (and off the backs of labourers), it was cheap and easy to move, for it 'cease[d] to act like solid objects and began to behave more like liquids: golden streams that flowed like water' (Cronon 1991, 113). The one-million bushel Grand Trunk elevator was positioned to empty lake freighters on the Lachine Canal side, load ocean freighters on the Windmill Point basin side and load and unload railcars through the middle at a rate of 100,000 bushels per hour. A 1910 concrete elevator was fifteen storeys high, had a capacity of 2.7 million bushels and could expel grain at a rate of 150,000 bushels per hour. The massive growth in the size of grain elevators between 1859 and 1910 reflects the increasing importance of the grain trade to Montréal over the industrial era. By 1921, Montréal had surpassed New York as the number one grain port of the world (Montreal Harbour Commissioners, *Annual Reports,* 1859–1914; St. Lawrence Grain company 1879; Tombs 1926; GRHPM 1981; Hanna 1998).

Discussion and Conclusions

On the eve of World War I, Frederick Cowie, chief engineer for the Harbour Commissioners, noted that

> A few years ago the bulk of Western grain came to Montreal in barges. These vessels, without machinery and with small crews, could afford to hold grain in storage until the ocean ship was ready for it ... With the enlargement of the canals, much of the grain now comes to Montreal in steamers ... These vessels cannot afford to wait, but must unload their cargo at once, otherwise they will not choose this port (Cowie 1913, 180).

Since the onset of industrialisation, inter-urban competition has operated as an external coercive power over individual cities, forcing them to yield to the discipline and logic of capitalist development, while inducing, and reproducing, certain patterns of development. Indeed, as Harvey (1989) reminds us, the roots of globalisation are old and deep. To capture a greater share of global trade from competing port cities, Montréal was compelled, over and over, to redimension the waterfront time-space. In this paper, I have shown how periodic innovations in transport and cargo-handling technology were preconditions for this redimensioning, and it is concluded that these changes emerged in response to commercial challenges to reduce the turnover time of capital.

The examination of the port reveals the several levels of competition, which are operative in a capitalist society—among ports, among cities, among entrepreneurs, between social classes and among workers. In the competition of cities, natural advantages were not enough to hold onto existing markets, to challenge for new markets and to draw trade away from rival port cities; Montréal was therefore compelled to repeatedly redimension its waterfront. This redimensioning, we have seen, generated new shapes and operations in a three-dimensional space: the Lachine Canal was dug, widened and deepened; the St Lawrence ship channel was repeatedly dredged, wider, straighter and deeper; numerous piers were added, elevated and lengthened; rail tracks were laid and augmented in parallel; and bridges and elevators were built and rebuilt with increased capacity. This paper makes an important contribution to our understanding of waterfront redevelopment by conceptualising the entire port as a comprehensive vascular system and explaining the redimensioning of various elements in relation to others.

The allometric exploration of port development presented in this paper combines an examination of the morphogenesis of the key arteries in the vascular system with an investigation of the changing characteristics of traffic circulation (the lifeblood of the port). The analysis revealed that massive increases in the number and size of ships through the port over the study period were correlated with the redimensioning of all of the connected parts of the system; that is, the expansion of the smaller capillaries like piers, as well as the major arteries such as the ship channel. Furthermore, the empirical evidence supports the theoretical argument that technical changes in the circulation and handling of goods—faster and more powerful ships, locomotives and machinery—were preconditions for the spatial and temporal redimensioning of the waterfront. The major innovations (e.g. steam engine and finger pier) were not initiated in Montréal, but globally in cities like Glasgow, Liverpool and rival New York City, and were then necessarily adopted by Montréal to stay competitive. Nevertheless, Montréal also implemented a few innovative local solutions, such as electric lighting and the floating elevator, to reduce the stay of ships in the port, and thus, reduce the turnover time of capital.

All these technological changes were developed by investors, ship owners, factory owners, land owners and railway owners, all caught up in their own levels of competition, each one continually striving to enhance circulation to expand their market base, lower costs and increase profits. Although they normally competed against each other in business, these entrepreneurs also worked together as members of the Harbour Commission, Board of Trade, Chambre de Commerce and various levels of government, and formed powerful growth coalitions which orchestrated the perennial redevelopment of the waterfront to facilitate the growth of port traffic, and to promote the city as the transportation hub and industrial powerhouse of the nation. It was argued that because investment in technology and infrastructure lagged behind demand, the efficiency of the port depended heavily on the organisation of transport and construction workers and the degree to which they could be exploited; it was accordingly revealed that the cyclical rhythm of investment in transport infrastructure over the industrial era was closely synchronised with waves of immigration, which expanded the pool of vulnerable low-wage workers. Waterman (1990) argues that because transportation is a kind of 'dead period' between investment and realisation, transport workers hold a critical station in the accumulation process. The findings of this research show waterfront workers in industrial Montréal periodically capitalised on their strategic position, but usually failed in their attempts to improve overall working conditions. Empirical evidence indicates that the tendency to strike was cyclical in nature, peaking during depression periods of low in-migration, when the competition among investors was periodically transferred to heighten competition between classes and among workers.

Today, due to the changing nature and importance of the shipping industry, the waterfront of Montréal offers a very different landscape to the one examined in this paper. Since the dominance of container shipping (introduced 1968), the working port has moved to more amenable sites further away from the city centre, and longshoremen have become nearly invisible in Montréal (McCalla 1994). While the forms and functions have changed dramatically since the nineteenth century, the primary forces driving the redevelopment of the waterfront have nevertheless remained more or less the same. Global changes in transport technology and cargo-handling procedures (primarily containerisation) were preconditions for the contemporary redimensioning of the Montréal waterfront, and these changes were adopted in response to commercial challenges to remove barriers to circulation and to reduce the turnover time of capital.

The 'Old Port' of Montréal, like many historic port districts across the world, has recently been re-created as a (post)modern landscape of leisure (Breen and Rigby 1996; Kilian and Dodson 1996; Norcliffe *et al.* 1996; Gordon 2000). Closed to shipping since 1970, the Lachine Canal was reopened to pleasure boats in the Spring of 2002. The old piers no longer convey grain into sheds, but visitors into an IMAX theatre, science centre, boutiques and the Cirque du Soleil. The last of the grain elevators now stand empty, and silo No. 5 has been adopted as a sounding board for a symphony of foghorns: a new 'postmodern' Romanticism. The canal and elevators are relics of a different time when Montréal was the number one grain port in the world. Their fate now lies in the hands of new growth coalitions that contemplate their aesthetic and cultural value, or 'symbolic capital', as heritage attractions to increase the throughput of tourists, rather than grain.

Acknowledgements

I am grateful for the insightful comments provided by the editors, Clarence Woudsma and Jean Andrey, and three anonymous reviewers. Sherry Olson, Len Evenden, Gordon Ewing and Raphael Fischler also kindly offered helpful advice on an earlier version. I also acknowledge the generous assistance of employees from the Archives du Port de Montréal and the Archives de la Ville de Montréal. Funding was provided by the Social Sciences and Humanities Research Council of Canada.

References

APPLETON, T.E. 1974 *Ravenscrag: The Allan Royal Mail Line* (Toronto: McClelland and Stewart)

ATHERTON, W.H. 1914 *Montreal, 1535–1914*, vol. 3 (Montréal: The S.J. Clarke Publishing Company)

—. 1935 *History of the Harbour Front of Montreal* (Montreal: City Improvement League)

BELL, R.B., NEWTON, S. and FLEMING, S. 1878 *Report on a General Scheme of Improvements for the Harbour of Montreal by the Commission of Engineers* (Montréal: Harbour Commissioners of Montreal)

BERGERON, D., BOUGIE, L., PINEAULT, D. and LÉPINE, L. 1983 *Canal de Lachine: atlas historique/Lachine Canal: Historic Atlas* (Ottawa: Parcs Canada)

BERRY, B.J.L. 1991 *Long Wave Rhythms in Economic Development and Political Behavior* (Baltimore: Johns Hopkins University Press)

BERTALANFFY, L.V. 1968 *General Systems Theory* (New York: George Braziller)

BONSOR, N.R.P. 1975 *North Atlantic Seaway* (New York: Arco Publishing Company)

BOSWORTH, N. 1839 *Hochelaga Depicta* (Montréal: Willian Greig)

BREEN, A., and RIGBY, D. 1996 *The New Waterfront: A Worldwide Success Story* (New York: McGraw-Hill)

BROEZE, F. 1991 'Militancy and pragmatism: an international perspective on maritime labour, 1870–1914' *International Review of Social History* 36, 165–200

BROUILLARD, P. 1979 'La Commission du Havre de Montréal (1850–1896)' in *Montréal: Artisans, Histoire, Patrimoine, Société Historique de Montréal* (Montréal: Fides) 83–102

CANADA 1889 *Royal Commission on the Relations of Capital and Labor in Canada*, vol. 5, Quebec Evidence (Ottawa: Queen's Printer)

CANE, J. 1846 *Topographical and Pictorial Map of the City of Montreal* (Montréal: Robert W.P., Mackay)

CHAMBERS, E.J. 1903 *The Book of Montreal: a Souvenir of Canada's Commercial Metropolis* (Montréal: Book of Montreal Co.)

COMMITTEE ON ROADS AND IMPROVEMENTS 1841 *To the Mayor, Aldermen and Citizens of the City of Montreal, Duly Assembled in Council* (Montréal: Committee on Roads and Improvements)

CONDIT, C.W. 1980 *The Port of New York* (Chicago: University of Chicago Press)

CORLEY, N. 1967 'The St. Lawrence ship channel, 1805–1865' *Cahiers de Géographie de Québec* 11, 277–306

COWIE, F.W. 1913 'The great national port of Canada: features of the important extension works in progress in Montreal harbor' *The Canadian Engineer* 22, 178–183

—. 1915 *The Transportation Problem in Canada, and Montreal Harbour* (London: The Institution of Civil Engineers)

CREIGHTON, D. 1970 *The Empire of the St. Lawrence* (Toronto: Macmillan)

CRONON, W. 1991 *Nature's Metropolis: Chicago and the Great West* (New York: W.W. Norton)

DAVID, G. 1919 *Carte de la Cité de Montréal* (Montréal: Montreal Map Publishing Co.)

DESLOGES, Y., and GELLY, A. 2002 *The Lachine Canal: Riding the Waves of Industrial and Urban Development, 1860–1950* (Sillery, QC: Septentrion)

DOIG, J. 2001 *Empire on the Hudson: Entrepreneurial Vision and Political Power at the Port of New York Authority* (New York: Columbia University Press)

EASTERBROOK, W.T., and AITKEN, H.G.J. 1958 *Canadian Economic History* (Toronto: Macmillan)

GILLILAND, J. 1999 'Redimensioning the urban vascular system: street widening operations in Montréal, 1850–1918' in *Transformations of Urban Form: From Interpretations to Methodologies in Practice*, ed G. Corona and G.L. Maffei (Firenze, Tuscany: Alinea Editrice) FK2.7–FK10

—. 2002 'The creative destruction of Montréal: street widenings and urban (re)development in the nineteenth century' *Urban History Review/Revue d'histoire urbaine* 31(1): 37–51

GOHEEN, P.G. 2000 'The struggle for urban public space: disposing of the Toronto waterfront in the nineteenth century' in *Cultural Encounters With the Environment*, ed A.G. Murphy and D.L. Johnson (Lanham, MD: Rowman and Littlefield)

GOLDRICK, M.,, and MERRENS, R. 1996 'Toronto: searching for a new environmental planning paradigm' in *City, Capital and Water*, ed P. Malone (London: Routledge) 219–239

GORDON, D.L.A. 2000 'Managing change on the urban edge: implementing waterfront redevelopment in Toronto' in *(Re)Development at the Urban Edges: Reflections on the Canadian Experience*, ed H. Nicol and G. Halseth (Waterloo: University of Waterloo, Department of Geography Publication Series) 175–226

GREENBERG, K. 1996 'Toronto: the urban waterfront as a terrain of availability' in *City, Capital and Water*, ed P. Malone (London: Routledge) 195–218

GRHPM 1981 *Construction des élévateurs à grain du Port de Montréal 1885–1970* (Montréal: Société du Port de Montréal)

—. 1982 *Travaux d'aménagement du Havre de Montréal 1830–1850* (Montréal: Société du Port de Montréal)

HAMELIN, J., LAROCQUE, P. and ROUILLARD, J. 1970 *Répertoire des grèves dans la province de Québec au XIXe siècle* (Montréal: HEC)

HAMELIN, J., and ROBY, Y. 1971 *Histoire économique de Québec, 1851–1896* (Montréal: Fides)

HANNA, D.B. 1986 'Montréal, a city built by small builders' Unpublished PhD Thesis, McGill University, Montréal

—. 1998 'The importance of transportation infrastructure' in *Montreal Metropolis, 1880–1930*, ed I. Gournay and F. Vanlaethem (Montréal: Canadian Centre for Architecture) 45–57

HARVEY, D. 1985 *Consciousness and the Urban Experience* (Baltimore: Johns Hopkins University Press)

—. 1989 *The Condition of Postmodernity* (Cambridge: Basil Blackwell)

—. 2001 *Spaces of Capital: Towards a Critical Geography* (New York: Routledge)

HEAP, M. 1977 'La grève des charretiers à Montréal, 1864' *Revue d'histoire de l'Amérique française* 31, 371–395

HOSKINS, R.F.H. 1989 'An analysis of the payrolls of the Point St. Charles shops of the Grand Trunk Railway' *Cahiers de Géographie du Québec* 33, 323–344

HOYLE, B.S., and PINDER, D.A., eds. 1981 *Cityport Industrialization and Regional Development: Spatial Analysis and Planning Strategies* (Oxford: Pergamon Press)

—. 1988 'Development dynamics at the port-city interface' in *Revitalising the Waterfront*, ed B.S. Hoyle, D.A. Pinder and M.S. Husain (London: Belhaven) 3–19

HOYLE, B.S., PINDER, D.A. and HUSAIN, M.S., eds. 1988 *Revitalising the Waterfront* (London: Belhaven)

IMLAH, A.H. 1958 *Economic elements in the Pax Britannica: Studies in British Foreign Trade in the Nineteenth Century* (Cambridge, MA: Harvard University Press)

ISARD, W. 1942a 'Transport development and building cycles' *Quarterly Journal of Economics* 57, 90–112

—. 1942b 'A neglected cycle: the transport-building cycle' *The Review of Economic Statistics* 24, 149–158

JANELLE, D. 1968 'Central place development in a time-space framework' *The Professional Geographer* 20: 5–10

KEEFER, T.C. 1850 *The Canals of Canada: their Prospects and Influence* (Toronto: Armour)

KILIAN, D., and DODSON, B. 1995 'The capital see-saw: understanding the rationale for the Victoria and Alfred redevelopment' *South African Geographical Journal* 77, 12–20

—. 1996 'Forging a postmodern waterfront: urban form and spectacle at the Victoria and Alfred Docklands' *South African Geographical Journal* 78, 29–40

KINGSFORD, W. 1865 *The Canadian Canals: Their History and Cost, With an Inquiry Into the Policy Necessary to Advance the Well-being of the Province* (Toronto: Rollo and Adam)

LEACOCK, S. 1963 *Leacock's Montreal* (Toronto: McClelland and Stewart)

LELIÈVRE, F., WILSON, P. and POUSSART, A. 1999 *Montréal, par ponts et traverses* (Montréal: Editions Nota Bene)

LEWIS, R. 2000 *Manufacturing Montréal: the Making of an Industrial Landscape, 1850 to 1930* (Baltimore: The Johns Hopkins University Press)

LINTEAU, P.-A. 1972 'Le développement du port de Montréal au debut du 20e siècle' *Historical Papers* 181–205

LINTEAU, P.-A., DUROCHER, R. and ROBERT, J.-C. 1983 *Quebec: A History 1867–1929* (Toronto: James Lorimer & Company)

LINTEAU, P.-A. 1985 *The Promoter's City: Building the Industrial Town of Maisonneuve, 1883–1918* (Toronto: Lorimer)

LINTEAU, P.-A. 1992 *Histoire de Montréal depuis la confédération* (Montréal: Boréal)

LOGAN, J.R., and MOLOTCH, H.L. 1987 *Urban Fortunes: The Political Economy of Place* (Berkeley, CA: University of California Press)

MALONE, P. ed. 1996 *City, Capital and Water* (London: Routledge)

MANDEL, E. 1975 *Late Capitalism* (London: NLB Press)

MARX, K. 1973 *Grundrisse: Foundations of the Critique of Political Economy* (Harmondsworth, UK: Penguin)

MCCALLA, R.J. 1994 *Water Transportation in Canada* (Halifax: Formac Publishing Company)

MCILWRAITH, T.F. 1976 'Freight capacity and utilization of the Erie and Great Lakes canals before 1850' *The Journal of Economic History* 36, 852–877

MCILWRAITH, T.F. 1991 'Digging out and filling in: making land on the Toronto waterfront in the 1850s' *Urban History Review/Revue d'histoire urbaine* 20, 15–33

MEYER, H. 1999 *City and Port* (Utrecht: International Books)

MONTREAL 1864–1901 (annual) *Report of the Inspector of Buildings* (Montréal: Corporation of the City of Montréal)

MONTRÉAL BOARD OF TRADE 1893 *Semi-Centennial Report of the Montreal Board of Trade and Report of the Council for the Year Ending 31st December 1892* (Montréal: The Board)

MONTREAL GENERAL RAILWAY CELEBRATION COMMITTEE 1856 *Montreal in 1856: A Sketch Prepared for the Celebration of the Opening of the Grand Trunk Railway of Canada* (Montreal: John Lovell)

MONTREAL HARBOUR COMMISSIONERS 1830–1918 *Annual Report of the Montréal Harbour Commissioners* (Montréal: Harbour Commissioners)

MONTREAL HARBOUR COMMISSIONERS 1855 *Reports in Relation to the Affairs of the Harbour Commissioners of Montreal and the Deepening of the Ship Channel in Lake St. Peter and the River St. Lawrence* (Montréal: John Lovell)

MONTREAL HARBOUR COMMISSIONERS 1884 *Official Documents and Other Information Relating to the Improvement of the Ship Channel Between Montreal and Quebec* (Montreal: Harbour Commissioners of Montreal)

MORRISON, J. 1976 'Ethnicity and violence: the lakehead freight handlers before world war I' in *Essays in Canadian Working Class History*, ed G.S. Kealey and P. Warrian (Toronto: McClelland and Stewart) 143–160

MORTON, D., and COPP, T. 1980 *Working People* (Toronto: Summerhill Press)

NORCLIFFE, G., BASSETT, K. and HOARE, T. 1996 'The emergence of post-modernism on the urban waterfront' *Journal of Transport Geography* 4, 123–134

OLSON, S. 1997 *Baltimore, The Building of an American City* (Baltimore: Johns Hopkins University Press)

PRED, A.R. 1990 *Lost Words and Lost Worlds: Modernity and the Language of Everyday Life in Late Nineteenth-century Stockholm* (Cambridge: Cambridge University Press)

RAMIREZ, B. 1991 *On the Move: French-Canadian and Italian Migrants in the North Atlantic Economy, 1860–1914* (Toronto: McClelland & Stewart)

RODRIGUE, J.-P. 1999 'Globalization and the synchronization of transport terminals' *Journal of Transport Geography* 7, 255–261

ROUILLARD, J. 1989 *Histoire du syndicalisme au Québec. Des origins à nos jours* (Montréal: Boréal)

SCHUMPETER, J.A. 1950 *Capitalism, Socialism, and Democracy* (New York: Harper)

SHERIFF, C. 1996 *The Artificial River: The Erie Canal and the Paradox of Progress, 1817–1862* (New York: Hill and Wang)

SLACK, B. 1975 *Harbour Redevelopment in Canada* (Ottawa: Department of State for Urban Affairs)

SLACK, B. 1988 'The evolution of Montréal's port service industry' *The Canadian Geographer/Le Géographe canadien* 32, 124–132

SLACK, B. 1995 'Container shipping networks and trade patterns in North American ports' in *Transport Planning and Policy Issues: Geographical Perspectives*, ed J. Andrey (Waterloo: University of Waterloo, Department of Geography Publication Series) 1–23

SLACK, B. 1999 'Across the pond: container shipping on the North Atlantic in the era of globalisation' *GeoJournal* 48, 9–14

SLACK, B., COMTOIS, C. and MCCALLA, R.J. 2002 'Strategic alliances in the container shipping industry: a global perspective' *Maritime Policy and Management* 29, 65–76

SMITH, N. 1990 *Uneven Development: Nature, Capital and the Production of Space* (Oxford: Blackwell)

ST. LAWRENCE GRAIN COMPANY 1879 *Copy of Letters Referring to Grain Elevating in Montreal Harbour Addressed to the Board of Trade by the St. Lawrence Grain Co.* (Montréal: Montréal Board of Trade)

TALBOT, E.A. 1826 *Five Years Residence in the Canadas* (London: S.R. Publishers Ltd)

THWAITES, J. 1984 'La grève au Québec: une analyse quantitative exploratoire portant sur la période 1896–1915' *Labour/Le Travail* 14, 183–204

TOMBS, L.C. 1926 *National Problems of Canada, the Port of Montreal* (Toronto: Macmillan)

TRAUTWINE, J.C. 1859 *Reports on the Means of Improving the Present Harbour and the Construction of Docks at Montreal* (Montréal: John Lovell)

TULCHINSKY, G.J.J. 1960 *The Construction of the First Lachine Canal, 1815–1826* Master of Arts Thesis, McGill University, Montréal

TULCHINSKY, G.J.J. 1977 *The River Barons. Montreal Businessmen and the Growth of Industry and Transportation, 1837–1853* (Toronto: University of Toronto Press)

TULCHINSKY, G.J.J., and YOUNG, B.J. 2000 'Young, John' in *Dictionary of Canadian Biography/Dictionnaire Biographique du Canada, CD-ROM*, ed R. Cook and R. Bélanger (Toronto and Québec: University of Toronto/Université Laval)

URQUHART, M.C., and BUCKLEY, K.A.H. 1965 *Historical Statistics of Canada* (Toronto: Macmillan)

WATERMAN, P. 1990 *International Communication and International Solidarity: The Experience of the Coordinadora of Spanish Dockworkers* (The Hague: Institute for Social Studies)

WAY, P. 1997 *Common Labor* (Baltimore: Johns Hopkins University Press)

WEST, G.B., BROWN, J.H. and ENQUIST, B.J. 1997 'A general model for the origin of allometric scaling laws in biology' *Science* 276, 122–126

WHITEHAND, J.W.R. 1987 *The Changing Face of Cities: a Study of Development Cycles and Urban Form* (New York: Basil Blackwell)

WILLIS, J. 1983 *The Lachine Canal, 1840–1900: Preliminary Report* (Ottawa: Parks Canada)

WINSLOW, C., ed. 1998 *Waterfront Workers: New Perspectives on Race and Class* (Urbana, IL: University of Illinois Press)

WRIGHT, R.V. 1912 *Car Builders' Dictionary* (New York: Simmons-Boardman Publishing Company)

YOUNG, J. 1859 *Rival Routes From the West to the Ocean and Docks at Montreal* (Montréal: Salter & Ross)

YOUNG, J. 1876 *The Origin of the Victoria Bridge* (Montréal: D. Bentley)

YOUNG, J. 1877 *The Origin of the Ocean Mail Steamers Between Liverpool and the St Lawrence, and the Advantages of the Northern Route* (Montréal: D. Bentley)

YOUNG, B.J. 1972 'Railway politics in Montreal, 1867–1878' *Historical Papers/Communications Historiques* 89–107

YOUNG, B.J. 1978 *Promoters and Politicians: The North-Shore Railways in the History of Quebec 1854–1885* (Toronto: University of Toronto Press)

YOUNG, B.J., and TULCHINSKY, G.J.J. 2000 'Allan, Sir Hugh' in *Dictionary of Canadian Biography/Dictionnaire biographique du Canada, CD-ROM*, ed R. Cook and R. Bélanger (Toronto and Québec: University of Toronto/Université Laval)