ENGINEERING THE DEFENCE OF THE CANADAS:
LT. COL. JOHN BY AND THE RIDEAU CANAL
by Robert W. Passfield
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Abstract

The Rideau Canal was constructed, 1826-32, by Lt. Col. John By of the Royal Engineers as part of an effort to provide a secure line of interior water communications between Montreal on the St. Lawrence River and Kingston on Lake Ontario. As such, it was to be an integral component of a much larger defence scheme formulated by the Duke of Wellington, the Master General of the Ordnance, whereby a series of permanent fortifications were to be constructed at key positions in the Canadas and interconnected by a network of interior canals. The canals were to have 20 foot wide locks to enable gunboats, propelled by oar and sail, to circulate freely from Montreal through to the Niagara and North-West (Upper Canada) frontiers independent of the Great Lakes. Lt. Col. By, however, convinced the Ordnance that the Rideau Canal should be constructed with larger locks to accommodate steamboats; and therefore heavy costs were incurred which eventually exceeded by five fold the initial estimate for the Rideau project.

The following report traces the evolution of the decision to construct the Rideau Canal as a steamboat, rather than a gunboat, navigation and examines the various economic, engineering, technical, and commercial arguments at issue in the context of the strategical implications of each for the defence of the Canadas. Furthermore, the propriety of Lt. Col. By's conduct with respect to his superiors in London and his performance as a superintending engineer is commented upon in terms of his instructions and intercourse with the Ordnance, the peculiar problems encountered on the Rideau, and a cost comparison with other
canal and fortifications projects under the superintendence of military and civil engineers of eminence in their field. Lastly, the impact of the heavy Rideau expenditures on Wellington's scheme for engineering the defence of the Canadas is assessed, and the military utility of the Rideau Canal steamboat navigation reconsidered in the context of Canadian defence strategy as it had evolved to the 1840s.
Preface

On canal construction projects, the superintending engineer was faced with a multi-fold task with respect to the locks. He was required to determine the size of the locks, the layout (including the number of locks to be built), and the design details of the lock structure, as well as prepare working plans, and arrange for and superintend the construction work. Generally, the size of the locks was determined for the engineer by the dimensions of the boats which were intended to use the projected canal; and by the 19th century lock design had become fairly standardized, although the engineer might well modify the design in detail to improve it or realize a saving in labour and/or materials. The laying out of the locks was another matter. This required a good deal of effort and ingenuity on the part of the engineer. The layout could not be determined until after the completion of the preliminary survey, and might not be finalized until the excavation work was well advanced. In all cases, the aim was to minimize the excavation and embanking work as well as the number of locks, required where the lift given to the locks was variable, but averaged about eight to ten feet. The building of the locks was commonly given out to contractors; but the superintendence of their construction remained the responsibility of the engineer. It was of crucial importance and demanded constant attention at all stages of construction, either on the part of the engineer or more likely a competent Clerk of Works, to ensure good quality workmanship. In the absence of a strict supervision, the results could be disastrous even with the best of plans.
When Lt. Col. By of the Corps of Royal Engineers was appointed in March 1826 to prepare plans and an estimate for the proposed Rideau Canal and superintend its construction, he had already had a good deal of experience on a variety of construction projects. During an earlier tour of duty in Lower Canada, 1802-1811, then Lieutenant By had superintended the construction of a small batteaux canal, the Cascades Canal, on the upper St. Lawrence River; and he had worked on the strengthening of the defences of Quebec and supervised the construction of four Martello towers. At the same time, when off duty, he worked with a draftsman-surveyor, Jean-Baptiste Duberger, to build an elaborately detailed scale model of Quebec and the existing temporary citadel complex. In 1811, Captain By, promoted following his efforts on the Cascades Canal construction project, had been ordered back to England and then to Portugal where he took part in the conduct of the first siege of Badajoz (8 May 1811-10 June 1811) under the Duke of Wellington's command before being invalided home to recover from wounds received in that siege operation. Upon his recovery, he was placed in charge of the Royal Gunpowder Mills at Faversham, Purfleet, and Waltham Abbey, and held that post until August 1821 when on the military establishment being reduced, he was retired on half pay at the age of forty-two. During his period of service following his sojourn of duty in Lower Canada, Captain By had shown a keen interest in tackling engineering problems and designing new works. In 1811, he designed a truss bridge, on what he considered a revolutionary principle of design; and it was apparently subsequently constructed across the Mersey River near Liverpool (the Renson Bridge). Thereafter, immediately following his being placed in charge of the Royal Powder Mills, Captain By prepared plans for, among other things, a hydrochemical press for gunpowder. In his retirement, Major By appears to have continued an active
interest in civil engineering work, and canal construction in particular, as he was a close acquaintance of John Rennie, one of the leading British canal engineers of the age, as well as a correspondent of the Montreal businessmen who, as Canal Commissioners appointed by the Province of Lower Canada, were responsible for constructing the Lachine Canal in 1820-25. Over the span of his career prior to his work on the Rideau Canal, Lt. Col. By not only had a surprisingly wide and varied experience in heavy construction work, but appears to have excelled at every task assigned to his charge. This was particularly so with respect to the Cascades Canal project, where his fellow Officers of Engineers, and no doubt Col. Mann the commanding engineer for Canada at that time, held Lieutenant By in exceptionally high regard for the "great judgment and ability" evinced in his conduct of the work. Indeed, almost two decades later in March 1826, when General Mann, then Inspector General of Fortifications, was instructed by the Board of Ordnance to select an Office of Engineers to superintend the construction of the projected Rideau Canal - the most demanding of the several major construction projects that the Ordnance had then in contemplation - he did not hesitate to call on his former subordinate Lt. Col. By. Although retired from active duty for upwards of five years, Lt. Col. By was experienced in canal construction work and known to be an extremely able Officer and highly competent engineer. As an Officer in the Corps of Royal Engineers, Lt. Col. By had also, of course, received the benefits of regular instruction in the basic principles of the science of military engineering through following the prescribed course of study for engineering and artillery cadets at the Royal Academy, Woolwich, England, upon the completion of which he had received his commission, on 1 August 1799, as a Second Lieutenant in the Royal Artillery prior to his transfer five months later, on 21 December 1799, to the Corps of Royal Engineers.
On the Rideau Canal project, the duties and responsibilities of Lt. Col. John By as commanding engineer were clearly set forth in his instructions; but the size, design and final layout of the locks remained undecided long after construction work had commenced. Shortly after his arrival in British North America, Lt. Col. By requested permission to construct a steamboat navigation with much larger locks than those proposed for the gunboat canal planned by the Ordnance; and pending the decision of the Master General, the Duke of Wellington, and the Board of Ordnance, Lt. Col. By prepared plans for the recommended small gunboat lock as well as for the larger steamboat lock. However, the size of lock to be constructed on the Rideau navigation proved an exceedingly difficult matter to resolve as it involved a number of diverse factors relating to military and naval strategy, ship design, trade patterns, and comparative construction costs as well as technical arguments relating to the practicality of a steamboat canal, and to complicate matters, communications were decidedly slow between the Rideau and London. Finally in June 1828, a decision was reached in favour of constructing a medium sized lock capable of passing small river steamboats; and Lt. Col. By prepared a third plan for the approved lock which he then proceeded to construct. But thereafter costs increased rapidly until 1831 when expenditures outran not only the estimate accepted by Parliament for the project, but also the annual parliamentary grant in contravention of newly imposed financial regulations. At that point, the Treasury Board censured By's conduct, questioned his competence, and ordered his recall. In the subsequent furor over the enormous cost of the Rideau Canal, no effort was made to ascertain how the large expenditures had come about, or the extent of Lt. Col. By's culpability, if any, for the same as Treasury Board strove to strengthen Parliamentary control over expenditures on Colonial Defence projects. In consequence, Lt. Col. By's engineering reputation was left
somewhat clouded. To the uncertainties that have persisted regarding Lt. Col. By's professional competence, a recent work (George K. Raudzens, "The British Ordnance Department in Canada, 1815-55", Ph.D dissertation: Yale University, 1970, which has been published as The British Ordnance Department and Canada's Canals, [Waterloo: Wilfrid Laurier University Press, 1979]) has added a severe criticism of By's motives and conduct in committing the British government to the construction of a much larger canal than originally intended, and condemned him for incurring the resultant heavy expenditures which raised the ire of the Treasury Board with supposedly disastrous results for the defence of the Canadas.

More specifically, it is argued that Lt. Col. By was a man of great ambition who, to satisfy his personal designs and grandiose plans, deliberately opposed the orders of his superiors and the declared interest of his government and through guile, evasiveness, and good luck, managed by June 1828 to commit the British government to constructing a canal much larger than the supreme military strategist, the Duke of Wellington, or Major General Carmichael Smyth, the framer of the preliminary estimate for a gunboat navigation, wanted built. Thereafter, Lt. Col. By through taking advantage of the loose system of Imperial financial administration, the imprecise nature of his instructions, and a series of either careless or deliberately evasive estimates prepared by himself, managed to evade the limits imposed on his annual expenditures and carried on so extravagantly on the Rideau that costs escalated five fold over the preliminary estimate of $169,000 formed by the Ordnance for the project. In sum, Lt. Col. By was "one of the worst types of 'men on the spot!'", who in various British colonies during the 19th century took advantage of the loose system of Imperial financial control and direction to pursue their own empire building plans, and through presenting their superiors with a fait accompli forced
expensive new commitments on the British government contrary to the decided policy of the latter. In the case of Lt. Col. By, it is asserted that he exploited his position so blatantly that he brought the wrath of the Treasury Board down on himself and the Ordnance with the result that the system of Imperial financial control was tightened up and the Lords of the Treasury refused to countenance any further large scale expenditures on colonial defence projects. This was a minor disaster for the Ordnance as it meant that the Duke of Wellington's grand strategy for the defense of the Canadas, of which the Rideau Canal formed but a part, could not be carried to completion; and that no monies were forthcoming to finish the construction of the Ottawa River section of the Ottawa-Rideau navigation on the scale of Lt. Col. By's large Rideau Canal steamboat lock. As a result, the heavy expenditures on the enlarged Rideau locks were "largely wasted"; and the Rideau Canal as constructed by Lt. Col. By, although admittedly an impressive achievement, "left the Ordnance with more canal problems than benefits." All of these developments, it is concluded, were a direct result of the inadequacies of the Imperial system of administration which prevented the London authorities from restraining Lt. Col. By, their "man on the spot" from embarking on the construction of a much larger canal than was necessary and spending "unjustifiably excessive amounts of money" in the process.

What is surprising about this damning indictment of Lt. Col. By's integrity, not to mention the conclusion that large sums of money were squandered as a consequence of the decision to construct the canal with larger locks, is that it is contradicted (but not refuted) by the views of a number of contemporaries of Lt. Col. By and several historians have commented on Lt. Col. By's conduct and activities. The recorded comments of a number of Officers, Overseers and contractors who worked on the Rideau Canal, as well as of By's immediate superiors both in the Canadas and
at the Ordnance, have all been highly laudatory with respect to Lt. Col. By's achievements, character and conduct; and likewise, several historical works published to date, with the exception of the above mentioned work, have uniformly praised By's remarkable abilities and character as evidenced in the successful completion of the Rideau Canal project. (Extracts from various reports, commentaries, and historical works pertaining to Lt. Col. By and his works may be found in R. Moon, ed., Colonel By's Friends Stood Up, Crocus House: Ottawa, 1979. The best work published to date is Robert Legget, Rideau Waterway, Toronto: University of Toronto Press, 1955.)

In view of the argument presented in the Raudzen's work, and the absence of any effort to expound upon the events leading up to the Treasury Board's recall order of 25 May 1832, it is evident that Lt. Col. By's character and professional competence remain as much a matter of conjecture today as they were upon the completion of the Rideau Canal, if not more so. Not only was his competence as an engineer called into question on the basis of his having submitted to London a series of ever escalating estimates for the Rideau Canal project as construction proceeded; but he stands accused of having wilfully deceived the Ordnance into constructing the Rideau Canal on a much larger scale than its progenitors intended, and in consequence, of being responsible for the heavy costs incurred on that project to the lasting detriment of the military interests of the Ordnance. The present work represents an effort to resolve the conflicting testimony as to Lt. Col. By's conduct and engineering competence insofar as it concerns his role in constructing the Rideau Canal as a steamboat navigation, and more generally to assess the validity of his judgments as to how the Ordnance might best have proceeded in strengthening the defence of the Canadas and the role projected for the Rideau Canal in the same.
The first chapter of this report, entitled "The Rideau Canal Lock Size Debate: Steamboats versus Gunboats," sets forth the comments upon the various engineering, technical, commercial, military, and economic arguments and considerations that Lt. Col. By put forward in support of his recommendation that the Rideau Canal should be constructed as a large steamboat navigation, and delineates the initial reaction of the Ordnance to both Lt. Col. By's proposal and the propriety of his conduct. The second chapter, "Escalating Estimates and Expenditures," traces the evolution of the decision to construct the Rideau Canal as a steamboat navigation with larger locks, and expounds on the difficulties encountered and the heavy costs incurred thereafter. To better assess the validity of the various charges levelled against Lt. Col. By, these developments are commented on in the context of By's instructions, his engineering decisions, and on-going developments which gave rise to a series of estimates culminating in an estimate of 27 February 1832 which set the cost of the canal at £776,023.5.6, and resulted in the Treasury Board instructing the Ordnance to recall Lt. Col. By and replace him with "some Competent person." A third chapter, "A Broader Perspective," has been included to provide additional information which makes it possible to determine to what extent Lt. Col. By was responsible for the cost overruns incurred on the Rideau project in defiance of the Treasury Board, and to assess in the context of 19th century canal building technology and comparative construction costs, Lt. Col. By's competence as reflected in the decisions that were made, the work accomplished and the costs incurred. Lastly, a chapter entitled "Ordnance construction projects and the Defeat of Wellington's Grand Strategy" has been researched and written to determine whether the heavy expenditures incurred on the Rideau Canal project were directly responsible for the government of the day rejecting Wellington's defence strategy, and whether Lt. Col. By's
construction of the Rideau Canal as a steamboat navigation and the costs incurred in constructing it, did in effect leave the Ordnance military planners in the aftermath of its construction with more problems than benefits. Indeed, only through such a study set in the context of the Ordnance's efforts at engineering the defence of the Canadas, can the ambiguities surrounding Lt. Col. By's competence and conduct both as a superintending engineer and a subordinate of the Ordnance be cleared up, and the military significance of his Rideau Canal steamboat navigation assessed.

As this report has been written primarily to serve as an interpretation document, many of the arguments developed within have been elaborated on more than might otherwise have been the case and are accompanied by extensive explanatory endnotes and bibliographic references which it is hoped will be of particular use in developing themes of interpretation and story lines for the Rideau Canal project, as well as aid in placing the various structural components of the canal in a proper historical context. In addition, a brief appendix has been added commenting on the practicability, in so far as steamboats were concerned, of the dimensions adopted for the locks approved for construction on the Rideau Canal in June 1828.
Introduction

When Lt. Col. By arrived at Montreal in June 1826 to await his final instructions prior to commencing work on the Rideau Canal construction project, the size of the locks to be built had not been confirmed by the Master General, the Duke of Wellington, and the Board of Ordnance. In previous years, a variety of lock sizes had been proposed for the projected Rideau navigation. Lt. Jebb of the Royal Engineers in a report submitted to the Ordnance in 1816 had called for the construction of a number of locks, 60 feet long by 20 feet wide, for a batteaux navigation; and Samuel Clowes, a Civil Engineer, in his report to the Legislature of Upper Canada, 5 February 1825, had provided estimates for 53 locks on the Rideau Canal of three different dimensions: viz. for a sloop navigation with stone locks 100 feet by 22 feet with 7 feet of water on the sills at a cost of £230,785.14.1 1/2; a Durham boat navigation with stone locks, 80 feet by 15 feet with a 5 foot depth estimated at £145,802.7.8 1/2; and a narrow boat navigation with wooden locks 75 feet by 10 feet with a 4 foot depth at £62,259.8.10. The latter size was suggested to Clowes by the dimensions of the Grand Trunk Canal in England. The large volume of trade carried by that narrow lock canal convinced Clowes that a similar scale of canal, plied by an altered form of Durham boat, would suffice to meet all of the demands that might be made of it. But most importantly, Major General Sir James Carmichael Smyth of the Royal Engineers, in two reports to the Master General and Board of Ordnance (the North American Commissioners' Report of 9 September 1825, and a memorandum prepared at the behest
of the Master General for Lt. Col. By's perusal on 14 March 1826), had recommended that the Rideau Canal should be constructed on the same scale as the Lachine Canal at Montreal and the Grenville Canal then under construction on the Ottawa River: viz. with stone locks 108 feet by 20 feet with a minimum of 4-1/2 feet of water on the sills. The object Smyth had in mind was the construction of an uninterrupted gunboat navigation from Montreal to Kingston of which the Rideau Canal would form an integral part.\(^4\)

In effect, Major General Carmichael Smyth was thinking in terms of continuing a system that had been developed during the War of 1812 to convey troops, ordnance, munitions and supplies from Montreal to Kingston, but on an altered routing by way of the Ottawa River canals (the Grenville Canal around the Long Sault Rapids and similar short canals soon to be built at the Carillon and Chute à Blondeau rapids on the Ottawa River) and the projected Rideau Canal rather than by the long-established upper St. Lawrence River route which was highly vulnerable to American attack.
The Rideau Canal Lock Size Debate: Steamboats versus Gunboats

Gunboats and the defence of the Canadas

During the War of 1812, the St. Lawrence River had served as a life-line to Upper Canada, a vital corridor along which the troops and supplies required for the defence of the upper province were moved to Kingston from the ocean port of Montreal. A roadway, opened in 1808, connected Montreal and Kingston; but it was impassable for stage-coaches in the spring and fall and for heavy ordnance at any time. In consequence, the bulk of the transport in war time, as prior to the war, was carried overland only from Montreal harbour to Lachine, a distance of roughly eight miles across the island, and then was loaded in batteaux which moved upriver in brigades from Lachine to Kingston via the St. Lawrence River. The batteaux, which were flat-bottomed skiffs, pointed at both ends and roughly 30 to 40 feet long and 6 to 8 feet wide, were capable of carrying 5 tons of freight with a draught of as little as 20 inches when fully loaded. They were rowed up the St. Lawrence as far as Prescott from which point they were able to sail, with favourable winds, to Kingston. Generally, the batteaux kept close to shore in moving upstream, and were dragged through the shallow rapids by means of ropes attached to windlasses, men or oxen, after their cargoes had been unloaded and portaged where necessary on the 12 day voyage from Lachine to Kingston. With the outbreak of war, some means had had to be found to protect the batteaux brigades from attack on the upper St. Lawrence River; and after an initial abortive effort to
protect the batteaux with soldiers, the Admiralty in 1813 had organized a gunboat establishment which came to be stationed at Coteau du Lac where the batteaux were henceforth assembled to be convoyed by gunboats to Kingston. Previously, gunboats had been used for attacking American merchant ships; but once their value in protecting batteaux brigades was realized, a gunboat building programme had been initiated that continued to the end of the war.

Gunboats were basically galleys ranging from 40 feet long by 8 feet wide, to 60 feet by 16 feet, and equipped with 22 to 26 oars. Sail was also carried, the gunboats being variously rigged as schooners, luggers, sloops, etc. They had a dead-weight tonnage of anywhere from 24 to 56 tons, and drew slightly less than three feet of water when loaded with crew, armaments and ammunition so that they were ideally suited for service in the shallow waters around the Thousand Islands in the upper St. Lawrence River where larger fighting ships could not penetrate or were often becalmed. The early gunboats had a variety of weaponry consisting of one or two, and occasionally three, guns, either 6, 12 or 18 pounders; but by 1814, the gunboats being constructed were generally armed with two guns: a 24 pounder long gun on a pivot and a 32 pounder short range carronade. Each gunboat had a crew of 38 well-armed sailors and carried 40 fighting men, either militia or British regulars, under the command of an officer. Indeed, by 1814, in the face of American threats to cut the St. Lawrence River supply line to Upper Canada, the gunboat establishment came to be regarded as being of much more strategic importance than the regular naval squadrons on the lakes; and the best seamen were transferred to the gunboats at a time when as many as 200 batteaux a week were arriving at Kingston laden with war materiel. Such was the importance attached to gunboats that the six gunboats in service at the outbreak of the war
had grown, even with war-time losses, to the point where in January 1814, there were 14 gunboats in service on the Great Lakes-St. Lawrence system, a further six under construction, and 9 in service in the Lake Champlain-Richelieu River theatre. As the war progressed, the gunboats proved to be extremely versatile in a variety of roles. They were, of course, used for convoy duty on the St. Lawrence River, and in addition were employed in scouting duties and played an essential role in combined military-naval operations against American-held positions such as in the May 1813 attack on Sackett's Harbour, the June 1813 re-capture of Fort George, and the May 1814 assault on Oswego where in each case the gunboats, aided by armed schooners, protected the batteaux transporting the soldiers, and helped in landing the troops and providing covering fire at close range. Elsewhere, they were an important component in the defence of the water approaches to Kingston and Montreal, and proved themselves capable on occasion of using their greater manoeuvrability to cut off much larger warships and force them to strike their colours. In sum, during the War of 1812, gunboats had proved to be highly manoeuvrable and effective fighting and convoy vessels; and although the Rush-Bagot agreement, concluded 28 April 1817, precluded their use thereafter on the lakes, the gunboats which had been decommissioned and hauled out of the water at the conclusion of the war were not forgotten. They still continued to be regarded by the British Admiralty as having an essential role to play in keeping the St. Lawrence River communications system open and for active service on the Great Lakes and Lake Champlain in any future conflict. To this end, when the Province of Lower Canada proposed to build a canal from Montreal to Lachine to by-pass the Lachine Rapids, the Admiralty insisted that it be constructed with locks sufficiently large to pass gunboats: viz. 20 feet by 108 feet; and the British government
contributed money towards the construction (1821-1825) of the Lachine Canal as part of a bargain to that end.\textsuperscript{21}

In the aftermath of the War of 1812, military strategists were in accord in holding that the preservation of a water communication between Montreal and Kingston was the \textit{sine qua non} for the defence of Upper Canada; and that there was no hope of keeping the upper St. Lawrence stretch of the existing water communication open in any future conflict with the United States. An interior line of water communication independent of the St. Lawrence River therefore had to be constructed;\textsuperscript{22} and gunboats were counted on again for service on the inland waters, and in particular for convoy duty in protecting the brigades of batteaux and Durham boats which would be used to transport war materiel and troops from Montreal to Kingston.\textsuperscript{23}

Since their introduction on the St. Lawrence River ca. 1809, Durham boats had begun to overtake the batteaux as the main vessel of commerce on the river; as they not only possessed the light draught characteristic of the batteaux but had superior sailing qualities and a much greater tonnage capacity (8 tons upstream, 35 tons downstream). The Durham boats were flat-bottomed barges with rounded bow and stern, and were some 60 feet long with a 9 to 13-1/2 foot beam. They were equipped with a large sloop sail to take advantage of favourable winds, but otherwise were poled up the river by the crew members walking along the length of a narrow gangway on either side of the boat.\textsuperscript{24}

Nonetheless, regardless of the type of vessel employed, moving freight and supplies up the St. Lawrence remained a laborious, costly, and slow process requiring, as it had during the war, roughly twelve days for a trip from Lachine to Kingston;\textsuperscript{25} and the deficiencies of that transportation system were a key consideration in the shaping of the post-war strategy for the defence of Upper Canada.
The need to develop an interior water communications system between Montreal and Kingston independent of the upper St. Lawrence River dictated the construction of the Ottawa and Rideau canals and the use of gunboats thereon for the protection of transport vessels enroute to Kingston; but, equally important, the limitations imposed by existing modes of transport determined that Great Britain would never be able to acquire, let alone maintain, a naval superiority on the Great Lakes. British military and naval strategists were in agreement that the modes of conveyance on the St. Lawrence, not to mention the difficulties and distances to be overcome in transporting ordnance and naval supplies to the lakes when compared to the relatively good year-round communications and abundant close-at-hand resources enjoyed by American shipyards on Lake Ontario, ruled out any prospect of the British forces gaining a naval ascendancy on the Great Lakes in any future shipbuilding race. The strategy developed by the Duke of Wellington, in March 1819 for the defence of Upper Canada therefore sought to obviate this difficulty through advocating the construction of a network of interior lines of water communications between a number of strong, strategically positioned forts, so that troops, war materiel, and heavy ordnance could be moved independent of the Great Lakes. This was a purely defensive strategy as American naval superiority had to be accepted, and in Wellington's judgement would preclude any attack being successful carried against the United States from the Canadas. As developed further in 1825, offensive operations, with the possible exception of strikes against the Erie Canal at several vulnerable points close to the frontier to destroy that transportation link, were to be confined to the Atlantic coast of the United States where British naval superiority could be brought to bear in blockading American commerce and landing armies as large as 25,000 men to attack and occupy key positions on the American coast. Military operations in the Canadas
therefore were to be purely of a holding nature, preserving the provinces from attack or occupation until decisive action could be taken elsewhere. Nonetheless, Wellington was confident that if the water communications and forts were built and regular troops deployed in the numbers recommended, then British troops and militia reinforcements could be moved, by batteaux and Durham boats under the protection of gunboats, to any fort under attack and in sufficient strength to defeat whatever invasion force the Americans might be capable of mustering "however formidable their power."  

In formulating his plan for the defence of the Canadas, Wellington accepted the orthodox military view that the primary objective had to be the preservation of Quebec, Montreal and Kingston; and to that end, the development of a secure water communication between them for the movement of troops and supplies from England. Hence the need to construct the Rideau and Ottawa River canals and the British government's subsequent contribution to the Lachine Canal project. But Wellington had also been concerned to develop a viable defence for the exposed frontiers of Upper Canada; and therefore, he had recommended that the interior water communications system should be extended: viz. that the Trent waterway be made navigable from Kingston via the Bay of Quite, Trent River, and interior lakes through to Lake Simcoe and beyond to Lake Huron; that the Ouse (Grand) River emptying into Lake Erie and the Thames River flowing into Lake St. Clair be made navigable and linked up by a canal to enable gunboats to pass between the latter two lakes; and lastly, that the headwaters of the Ouse River and the Holland River, flowing north into Lake Simcoe, should be joined by a canal to connect Lake Erie with Lake Simcoe and via the Trent system with Lake Ontario. Such a water communication would enable troops and supplies to be moved in perfect security to all of the lakes, yet independent of control of the lakes, for the defence of the Niagara and
upper lakes frontiers. To complete the defence plan, Wellington advocated a reduction in the number of existing small forts and blockhouses strung out along the extended frontiers of the Canadas in favour of a small number of permanent fortifications capable of withstanding a siege conducted by a large army. The forts were to be situated so as to be able to defend key areas, and garrisoned with regular troops deployed as follows: 1,000 at Quebec, 500 at Montreal, 500 along the Richelieu in the several forts protecting the southern approach to Montreal, 500 at Kingston and 500 split between the Niagara frontier and Penetanguishene, together with in each case detachments of the local militia. In aid of the garrisons Wellington further recommended that a field force of two corps be created, each consisting of 5,000 regulars and 3,000 well-trained militia. The left corps was to be stationed on the projected Rideau Canal at the mouth of Irish Creek (just upstream from Merrick's Mills), and the right corps between the headwaters of the Ouse and Holland rivers. From these positions one corps or the other could move to provide support for the garrisons at Montreal, Kingston, York or Niagara whenever an attack were mounted against them. Moreover, even though the Americans might well have an overall naval superiority on the lakes, the interior network of water communications would enable the British forces to concentrate their smaller naval craft (the gunboats) to gain a local superiority at will on any one of the lakes. With respect to the Rideau system, Wellington calculated that the left corps could move from its base by water to Montreal in four days, to Kingston in 2 or 3 days, or to Lake Simcoe (45 miles to the rear of York on a good road communication, Yonge Street) in 6 or 8 days.32

Wellington's defence plan of 1819 had been accepted by the British government, and within a year work was commenced on three major construction projects: the building of a citadel at Quebec; the construction of a new fort (Fort
Lennox) on Isle aux Noix in the Richelieu River; and the excavation of the Grenville Canal on the Ottawa River. In April 1825, Colonel Sir James Carmichael Smyth was sent to North America to preside over a commission of Royal Engineers acting under instructions from the Duke of Wellington to prepare a detailed report on the state of the defences of British North America, the works in progress, and more specifically the feasibility, cost, and engineering staff required to construct the water communications and fortifications needed to complete the 1819 plan of defence, as well as to determine the best position or site for the respective works. Smyth, newly promoted to Major General, reported on 9 September 1825 that all of the water communications were feasible, with the sole exception of the Holland-Ouse (Grand) rivers canal link; but the latter canal communication was no longer necessary as the Province of Upper Canada was engaged in building a canal, the Welland Canal, to connect lakes Erie and Ontario. Moreover, Smyth recommended that the first phase of construction should concentrate on the most strategically important works on the Quebec-Kingston sector with the other works being postponed until the more essential works were completed. Smyth advocated that £239,000 be expended on essential canal construction work for the building of the Rideau Canal (estimated cost £169,000) and the Ottawa River canals (estimated total cost £70,000); and that a further £1,141,218 would be required for constructing the fortifications required in the Canadas, exclusive of the £220,000 already estimated for the Quebec citadel and the £86,726 estimated for Fort Lennox, both of which were still under construction. Among the new works required were a citadel on Mount Royal (estimated cost £250,000), and new fortifications at Kingston (£201,718) to protect the southern entrance to the Rideau Canal as well as the naval establishment and Dock Yard there. The southern approach to Montreal had to be defended through the construction of
fortified barracks with outer works at St. Jean (£50,000) and Chambly (£50,000) on the Richelieu River, and at the mouth of the Chateauguay River (£55,000) and upstream on the same river (£50,000), and on St. Helen's Island opposite Montreal (£42,500). In the western peninsula of Upper Canada, the canals were to be postponed; but a major fort had to be built at the Short Hills on the Niagara frontier (estimated cost £250,000) as well as fortified barracks with their outer works on the Ouse (Grand) River (£50,000), at Chatham on the Thames River (£50,000), at Amherstburg on the Detroit River (£62,000), and Penetanguishene on Georgian Bay (£30,000). In sum, according to Smyth's estimate it would cost a total of £1,686,944 to construct the fortifications required to implement Wellington's defence plan together with the water communications on the critical Quebec-Montreal-Kingston life line, exclusive of the water communications network to be constructed at a later date in the interior of Upper Canada. Moreover, a further £266,000 was added to the estimate to cover the cost of constructing a citadel and several secondary forts needed to strengthen the defences of Halifax.36

Whether or not the British parliament could ever be brought to acquiesce in the large appropriations required to complete the plan of defence worked out by the Duke of Wellington and Major-General Carmichael Smyth, it is clear that the Rideau Canal project in the eyes of its progenitors was but a part, but an essential part nonetheless, of a well thought out strategy for the defence of the Canadas. Gunboats had played a vital role in preserving the Canadas during the War of 1812; and now that the futility of seeking to gain a naval supremacy on the Great Lakes through the construction of large warships was accepted, gunboats were being counted on more than ever to defend the water approaches to key forts and, on the projected interior canals, to maintain the free movement of troops, ordnance, and supplies crucial to the defence of the Canadas. The
Rideau Canal, for its part, was intended to provide an uninterrupted and secure navigation for the circulation of gunboats, which were in turn to be used to protect the bateaux and Durham boats moving troops and supplies between Montreal and Kingston for the defence of Upper Canada, and moving in reverse should Montreal come under attack; and the size of the locks to be built was determined accordingly. In such a situation, it was highly unlikely that any scheme for changing the size of the locks would be countenanced, particularly if it were to entail a radical change in the whole thrust of the prevailing defence strategy as it pertained to Upper Canada as well as substantial increase in the cost of constructing the canals on the projected Montreal-Kingston navigation system.

In so far as the Rideau Canal was concerned, the size of the locks to be built was finalized on 15 June 1826 when the Duke of Wellington officially approved Major General Smyth's memorandum as the basis of By's instructions. Lt. Col. By, however, did not receive the packet containing his complete instructions, including Wellington's confirmation of the lock size, until 4 September 1826 by which time he had already formed and expressed his own views as to what size of locks should be built and was awaiting a reply.

By's arguments in favour of a large lock steamboat navigation

While resident in Montreal during the summer of 1826, Lt. Col. By busied himself in gathering information pertaining to the construction of canals, and the Rideau Canal in particular, and in examining the defences of the Canadas. To that end, he visited not only the Lachine Canal and the Grenville Canal, the latter then being constructed under the supervision of the Royal Staff Corps, but also fortifications in the area including the new fort under construction at Isle aux Noix on the Richelieu River.
As a result of these investigations, and communications received from Montreal merchants, By became convinced on both military and commercial grounds that the Rideau navigation ought to be constructed on a much larger scale than that proposed by Major General Smyth. Consequently in his first report to the Board of Ordnance, dated 13 July 1826, Lt. Col. By presented an argument in favour of constructing larger locks.39

In his report, By stated his conviction that the Canadas could be best defended and rendered secure by constructing a steamboat navigation to connect the Great Lakes with the St. Lawrence River by way of the Welland, Rideau and Ottawa River canals and linking this system to Lake Champlain by means of canal works on the Richelieu River. Such a navigation system when completed would not only serve to prevent the Americans attacking the Canadas, but would give Great Britain control over the trade of the fertile hinterland of the Great Lakes. An uninterrupted steamboat navigation would draw all of the trade of that region down the St. Lawrence, and the American barge canals constructed to capture that trade would be turned into tributaries of the system carrying British manufactured goods into the interior thereby opening up new markets for British manufactures. The steamboats engaged in this trade, moreover, could be quickly adapted to military purposes in time of war as each boat was capable of being armed with four 12 pounders and transporting at least 700 men. Lt. Col. By estimated that the number of steamboats then in use on the various rivers and lakes was sufficient to move an army of 10,000 men with all its equipment if the various waterways were connected with locks sufficiently large to pass the steamboats. As trade increased, the number of steamboats would increase thereby providing a constant increase of military power ever ready for deployment at no additional expense to the government. With the mobility which such a system of navigation would provide, British
forces could be marshalled in strength at any given point on
the frontier with a rapidity of movement that the Americans
could not match on land. Consequently, control of the lakes
could be maintained in British hands and a perfect security
provided against American attack. The construction of such
a navigation system, By maintained, was by no means beyond
the means of the government and was ultimately the most
economical way of defending the Canadas.

The construction of such a navigation system involved
building several new, but relatively short canals, and
enlarging the locks of several major canals then under
construction or about to be constructed, to accommodate
steamboats of a size well adopted to operating on the lakes
and major rivers of North America. These boats, By stated,
were from 110 to 130 feet long with a 40 to 50 foot beam and
drew 8 feet of water. To that end, he strongly recommended
that a short canal with one or two large locks be built
north of the island of Montreal to by-pass the small locks
of the Lachine Canal, and that the locks of the Ottawa River
and Welland canals, both of which were then under
construction, be increased in size as well as those
projected for the Rideau Canal. To complete the system, a
number of large locks would have to be built on the
Richelieu River, and a work of insignificant cost
constructed at St. Mary's between lakes Huron and Superior.
If given authority to proceed, By was confident that he
could complete the construction of the whole system on the
large scale required in 4 or 5 years. He projected that it
would cost in total some £1,200,000, including roughly
£400,000 for the Rideau Canal. This expenditure, he
maintained, was "of no moment" when the military, not to
mention the commercial, import of the navigation system was
taken into account. Moreover, he was convinced that the
tolls levied on the canals would not only cover the interest
on the monies expended but recoup the principal as
well.40
After further study, By in a follow-up report dated 1 August 1826, elaborated on the revenue generating potential of his proposed steamboat navigation, and for the first time, provided information on the size of lock he felt should be built. He had ascertained that the tolls on the Lachine Canal were yielding 3 percent interest on the £109,601 expended on its construction, but noted that if the locks were larger the revenue could be doubled. Rafts of timber were unable to pass the small Lachine Canal locks without being totally broken up, and in consequence, most of the timbermen preferred to risk running the rapids. But if locks 150 feet by 50 feet with 10 feet of water on the sills, were built they would accommodate the timber trade as well as the steamboats. Estimating the amount of revenue such a navigation system would produce was admittedly a difficult task, but a number of merchants whom By had consulted believed that within a decade of its completion, the steamboat navigation with large locks would yield as much as 20 percent per annum on the projected cost of £1,200,000.41

Although By initially had advocated the larger lock size strictly for the benefits which would accrue from having a steamboat navigation, it had not taken him long to realize that the construction of such locks would be of immense importance in facilitating the carrying on of the timber trade which by the mid-1820s provided the principal export staple for the British North American colonies. The timber trade in British North America had developed during the Napoleonic Wars when the imposition of Napoleon's Contential System had deprived Great Britain of access to Baltic timber. Aided thereafter by British "differential duties", the British North American timber trade had continued to grow by leaps and bounds throughout the first half of the 19th century.42 During the decade of the 1820, the timber trade boomed with British North American providing 67 percent (within a decade increased to 83
percent) of British wood imports\textsuperscript{43} with the timber exports from Quebec, the export port for Canadian timber, accounting for as much as 74 percent of the total value of Canadian exports.\textsuperscript{44} This trade was quite extensive. In 1825, for example, 430,000 loads of timber and 15,000 great hundreds of deals were exported from the Canadas via Quebec.\textsuperscript{45} Getting this timber to Quebec with a minimum of damage and delay was of crucial concern not only to the timberman but all of the colonists for the economic well-being of the Canadas depended upon it.\textsuperscript{46}

The timber trade consisted for the most part of squared timber (and to a lesser extent naval stores), which in the Canadas was floated down the St. Lawrence River to Quebec from the upper lakes and rivers of the interior in large rafts with each raft being built up of smaller rafts or "drams" lashed together. Each dram was made by framing and pinning together some 200 "sticks" of squared timber to form a unit roughly 33 feet wide by 100 feet long. Red and white pine were used for the bottom, and the heavy oak timbers and small and long staves were secured on top. Each dram contained 8,000 to 10,000 cu. ft. of timber, sat low in the water with as much as a four foot draught, and was sufficiently strong to stand up to the turbulent waters of the St. Lawrence River rapids. On reaching the head of a rapids, the large rafts were separated into their component drams, and a small crew was placed on each dram to shoot it through. This was a dangerous undertaking which in the early years of the timber trade had occasioned numerous deaths and the breaking up of a good many drams on ledges and protruding rocks. However, all of the rapids on the St. Lawrence River were passable, if at great risk.\textsuperscript{47}

Lt. Col. By nonetheless believed that if locks large enough to pass drams existed, viz. the large locks he wished to build, the timbermen would prefer to pay a toll for passage through the locks rather than risk damage to the timber, and loss of life, through shooting the rapids.
It is not surprising that Lt. Col. By should have been struck by the economic, and after studying the defences of the Canadas, the military potential of steamboats. Steamboats were in use on the rivers and lakes of both North America and Britain by the second decade of the 19th century. The latter decades of the 18th century had witnessed various attempts in Britain, France and the United States to apply steam propulsion to boats with but indifferent success until after the turn of the century when Robert Fulton succeeded in establishing a viable commercial steamboat operation on the Hudson River following the launching of the North River Steamboat of Clermont in 1807.48 From there steamboats were introduced on the Delaware River in 1809, and to the Ohio-Mississippi river system in 1811-12.49 Indeed, the introduction of steamboats capable of attaining speeds of 5 to 7 miles per hour on the latter river system had brought about a virtual economic revolution by drastically reducing the time of transit and freight rates in moving goods and produce over vast distances, some 2,000 miles for example from Pittsburgh to New Orleans, and fostering thereby a rapid development of the American interior.50 By 1820, steamboats were plying up and down almost all of the tributaries, as well as the main stream, of the Ohio and Mississippi rivers, and had succeeded in establishing a monopoly over passenger and upstream freight traffic formerly carried in keel boats propelled by poling, sweeps, and at times sails.51 Moreover, at the same period commercial steamboat operations had been established in Britain and British North America. In Britain, the first regular steamboat service was instituted in 1812, with the Comet plying between Glasgow and Greenock on the Clyde River on which by 1815 there were ten steamboats operating. From there steamboats were introduced to other rivers of the British Isles.52 In British North America, regular steamboat runs were also introduced at an early date commencing with the launching of
John Molson's steamboat, the Accommodation, at Montreal in 1809. The Accommodation, which had a 6 horsepower engine capable of a speed of about 5 miles per hour, ran on the St. Lawrence River between Quebec and Montreal, and was soon joined by a number of steamboats built on the Upper St. Lawrence River and lakes Ontario and Erie.

The largest of the sidewheelers, and indeed the first to be built for service on the lakes, was the Frontenac, launched at Ernestown, Upper Canada, on 7 September 1816. It was of 740 tons burthen, drew 8 feet of water when loaded, and had a keel 150 feet long, a deck 170 feet long, and was 32 feet wide. Its two paddle wheels were forty feet in circumference and driven by a 50 H.P. Boulton and Watt engine. The Frontenac was a dual purpose steamboat conveying both passengers and freight between Prescott and Kingston, and was capable of a speed of 9 knots with a favourable wind. Steamboats constructed subsequently for service on the lakes, such as the Queen Charlotte launched in 1818 to ply between Prescott and the Bay of Quinte, were not quite so large. Lt. Col. By, of course, had investigated the size of steamboats plying the inland waters of the Great Lakes, Ottawa and St. Lawrence rivers, and found that the lake steamboats were generally 110 to 130 feet long with a 40 to 50 foot beam, and drew 8 feet of water when loaded. Thus, if the Rideau Canal were to be built with the 150 by 50 foot locks with 10 feet of water on the sills as By recommended, they would have been capable of handling all but several of the very largest lake steamboats.

When Lt. Col. By arrived in Montreal, there were at least nine steamboats in service on the Upper St. Lawrence and Lake Ontario alone, in addition to a small number on the lower St. Lawrence below Montreal, and one on the Ottawa River. The latter, the Union of the Ottawa, had been built at Hawkesbury in 1822 to run between Hull and the rapids at Grenville. The St. Lawrence River steamboats, however, were used mainly for carrying passengers and as tow
boats in contrast to the dual purpose steamboats on the
Great Lakes and the western rivers of the United
States. Indeed, in 1823 a company had been formed in
Montreal to build steamboats for towing sailing ships up
river from Quebec to Montreal.

The commercial viability and potential of steamboats
was manifest for all to see by 1826; and it was but a small
step for Lt. Col. By to contemplate the overwhelming
commercial advantages of an uninterrupted steamboat
navigation from the ocean port of Montreal up into and
through the Great Lakes. Moreover, he was aware of the
schemes of the Montreal merchants for re-establishing their
former hegemony over the trade of the interior Great Lakes
region (eliminated by the construction of the Erie Canal
which opened in 1825), through improving the navigation of
the St. Lawrence River. But where By showed a
superior quality of mind was in realizing the military
potential of steamboats, not to mention his later more fully
developed concept of a fluid, offensively oriented defence
(see below) based on secure interior lines of communication
and supply, the manufacture of ordnance in the interior, and
a superior mobility which would enable British troops to
make rapid strikes in force at any given point on the
Great Lakes frontier to forestall the mounting of American
attacks. In this respect, By's strategy encompassed a role
for the Rideau Canal, and Canadian canals in general, far
different than that contemplated by the Board of Ordnance
which had envisaged the Rideau navigation when completed as
providing primarily a safe interior passage for the
transport of troops, ordnance, and supplies to the fortress
of Kingston for the defence of the province of Upper Canada
and for the movement of troop reinforcements to relieve
Kingston or Montreal should either of these forts come under
siege. Here, the security and cost of transport were the
key considerations and not the speed of transit per se in
what was purely a defensive strategy; whereas in By's
strategy speed was of the essence, and steamboats were to provide the rapidity of movement essential to the viability of the whole strategy.

Whether Lt. Col. By was aware of it or not, steamboats had been used to a limited extent during the War of 1812 by both the British and American forces. In 1812, John Molson had launched a second steamboat, the Swiftsure with a powerful 28 horsepower engine, to ply between Montreal and Quebec together with the Accommodation. When war broke out, the Swiftsure because of its superior power and speed was employed in moving military supplies up river from Quebec to Montreal. The Americans had also been quick to make use of steamboats where available. The steamboat Enterprise launched in December 1814, carried ordnance and military supplies on her maiden voyage from Pittsburgh to New Orleans, and thereafter was used as a military transport during the defence of New Orleans. In the immediate post war years, the American Army had employed steamboats to transport troops and supplies up western rivers, such as the Mississippi, the Missouri, the Arkansas, and the Red rivers, to their western posts. But the scale on which Lt. Col. By wanted to move troops, ordnance and supplies (an army of 10,000 men or more), his intention to arm the steamboats (four 12 pounders per vessel), and especially his strategy of a mobile defence utilizing the speed of steamboats to enable military forces to be quickly moved over vast distances and concentrated rapidly in force, went far beyond what had ever been tried before. Indeed, steamboats were not to be used for the mass movement of troops and supplies on the scale, and for the purpose, envisaged by Lt. Col. By until the American Civil War, 1861-65.

During the American Civil War, fleets of steamboats, comprising as many as 70 to 80 vessels, were employed to move armies of upwards to 20,000 troops, including artillery, cavalry and baggage over distances of 450 miles
and more in a week, and were able to keep them supplied in the field. Both belligerents used steamboats, but it was the Union forces, operating on the Mississippi, Ohio, Tennessee and Cumberland rivers, that were best able to exploit the strategic potential of the steamboat to strike in force, quickly and deeply into the heart of enemy territory. In the western theatre, the steamboats operating on the navigable rivers had proved superior even to railways in moving and supporting an army in the field. In retrospect then, the military strategy underlying By's proposed steamboat navigation, was emminently sound; but it nevertheless remained to be seen if his reports would convince the Board of Ordnance to change the strategy on which the canal construction programme in the Canadas was based and authorize the building of the large sized lock. In the interim, however, there was no doubt as to what size locks By was instructed to build.

On 4 September 1826, Lt. Col. By received a package, dated 21 June 1826, containing his final instructions (or at least what was intended to be so) from the Board of Ordnance; and he immediately left Montreal for Hull to commence work in the field on the Rideau Canal project. His final instructions were to the effect that he was to build the canal in keeping with Major General Carmichael Smyth's memorandum of 14 March 1826 as modified by several additional comments made by the Master General, the Duke of Wellington, dated 15 June 1826. One of Smyth's recommendations, which Wellington confirmed, was that the canal should be constructed as a gunboat navigation with locks on the same scale as the Lachine and Grenville canals, viz. 108 feet long by 20 feet wide (with roughly 5 feet of water on the sills). These instructions for the most part merely reiterated the interim instructions that By had received prior to leaving England; and since they pre-dated the composition of his reports advocating the construction of the large locks, By still continued to regard that
subject as an open question. Unbeknownst to him, the Board of Ordnance had already considered his proposal and settled the matter.

Differing Views: The Board of Ordnance versus Lt. Col. By

The 13 July 1826 report wherein Lt. Col. By strongly advocated the expenditure of a total of £1,200,000, and quite possibly a good deal more, to construct a steamboat navigation system in the Canadas, had not arrived at the Ordnance Department at a propitious time. At that very moment in mid-August 1826, estimates were being prepared for submission to Parliament to cover the expenditures anticipated for 1827 on the Canadian canal construction projects. These estimates were prepared on the assumption that relatively limited sums would be required over a short period of time. Three canal projects required support to complete the Canadian navigation system: the Welland Canal, then under construction by a private company, and the Rideau and the Ottawa River canals being constructed by the Board of Ordnance and the Royal Staff Corps, respectively. The Welland was to be given a total contribution of £16,360 averaged over five years, and both the Rideau and Grenville canals, expected to be completed in 1831, were to be given annual appropriations: £15,000 per annum for the Grenville, and varying sums for the Rideau based on a projected final cost of £169,000. But most importantly, the Board was thinking in terms of requesting a total of £51,232 for canal construction work in the year 1827 (including £32,800 for the Rideau project) and similar sums thereafter. On cost alone then, By's scheme for a steamboat navigation involving as it did the expenditure of a vast, and by no means limited, sum of money was totally out of keeping with what the Master General and Board of Ordnance had in mind for spending to complete the inland navigation of the Canadas. Nonetheless, his scheme was subjected to serious study.
When Lt. Col. By's report of 13 July 1826 arrived at the Ordnance, it was forwarded immediately to Major General Sir James Carmichael Smyth for comment and then submitted to the Master General and Board of Ordnance together with Smyth's observations. Smyth rejected By's arguments in favour of constructing a steamboat navigation with the requisite large locks on technical as well as military grounds.

In his report, Smyth pointed out that steamboats could not be used in canals as the wash from their paddles would destroy the banks; and that otherwise the prescribed locks (108 feet by 20 feet with a minimum of 4½ feet of water on the sills) were sufficiently large "for every practical purpose." He reiterated for the benefit of the Master General, and indirectly Lt. Col. By to whom a copy of Smyth's remarks was forwarded, that:

The great object & use of the back water communication from Montreal to Kingston is to enable Government to forward Stores, Provisions, Ammunition & Troops to the Upper Part of the Province without risk of capture or being engaged in time of war in petty hostilities with the Americans on the St. Lawrence.

To that end, a lock size had been adopted which was sufficiently large to pass gunboats and the vessels used in carrying on the trade of the country (the Durham boats) so that revenues raised by tolls on the commercial traffic might pay for the cost of constructing the canals. The Lachine Canal had already been constructed on that scale and the Grenville Canal was being constructed with the 20 foot lock. Since steamboats could not operate on canals, there was no need to increase the dimensions of the locks as this would not increase the speed of transit or the revenue generated. Moreover, with respect to the Richelieu River, Smyth was of the opinion that it would be better to increase
impediments to its navigation rather than facilitate it (to the potential advantage of an American invading force). Smyth noted that By had not yet gone over the line of the projected Rideau Canal; and that he personally was of the opinion that the construction of the proposed large scale navigation would entail far more difficulties than Lt. Col. By seemed to imagine would be the case. He suggested that By should complete his plans, estimates and surveys for the building of the 20 foot locks on the Rideau system, at which point he could then form a better judgement "not only of the propriety, but of the possibility and the expense of extending the dimensions."69

The Master General, the Duke of Wellington, concurred completely in the views expressed by Major General Smyth as to the purpose and strategic implications of the canal system as well as the size of lock required. In particular, he agreed that it was impossible to operate steamboats on a canal for the reasons cited by Smyth, and added that towing the steamboats would be of little advantage. Moreover, the construction of a canal 50 feet wide would be enormously costly and time consuming. The Master General directed that By was "to proceed with alacrity" in carrying out the construction of the Rideau Canal in keeping with his original instructions, and to take whatever action was necessary to ensure that the project would be completed within four years. Nonetheless, By was informed that "His Grace will be always happy to receive his observations upon any part of it & his suggestions."70

Leaving aside the question of the cost involved which dictated heavily against By's scheme for constructing a steamboat navigation, there was much to be said in favour of the Ordnance decision based on the situation as it was perceived from England. This was especially so with respect to the technical argument regarding the impossibility of operating steamboats on canals and more general argument as to the utility of small or narrow lock canals.
Despite their unquestionable success on the rivers of the British Isles and North America, steamboats were not used on canals. In Great Britain, a number of experiments had been tried in operating steamboats on canals, among the earliest being several conducted on the Forth and Clyde Canal in 1801-03, but with very discouraging results. In every case, it had been found that the churning of the paddle wheels and the strong wake given off not only weakened or destroyed the banks by washing out the earth, but in doing so tended to silt up the canal. Experience had shown that the only effectual response was either to protect the banks by walling and/or paving, which was prohibitively expensive, or to eliminate the source of the problem. In consequence, steamboats were banned from British canals, and even the speed of horse-drawn canal boats was restricted. This, of course, was well known to the Board of Ordnance, and Major General Carmichael Smyth in particular, and accounts in large part for their rejection of By's scheme for a steamboat navigation through the canals of the Canadas; but there were also other considerations militating against large locks of the size proposed by Lt. Col. By.

In Britain at that time, canal locks varied in size but were generally on one of two different scales, either broad (or wide) locks roughly 13 feet wide and 65 feet long, or narrow locks 7 feet 6 inches wide by 70 feet long in the chamber. Canals connecting with river navigations were commonly built with broad locks to pass the sailboats engaged in the coastal trade which were some 60 feet long with a 12 foot beam and capable of carrying 60 tons with a 5 foot draft; whereas the inland canals were constructed with narrow locks and plied by flat bottomed narrow boats some 70 feet long with a 7 foot beam and a 30 ton carrying capacity. These boats on their respective canals had proved more than adequate to meet the demands of British trade as Samuel Clowes had pointed out in his report to the
Legislature of Upper Canada 5 February 1825. He had suggested, based on the viability of the narrow locks on the Grand Trunk Canal in England, that a narrow lock 10 feet wide by 75 feet long (the width increased by two feet to accommodate an altered form of Durham boat), would suffice for the proposed Rideau navigation. More generally, in North America the English lock standards were considered adequate for the carrying trade as both the narrow lock and the broad lock had their adherents among canal engineers.

American canal engineers, after studying the English canals preparatory to constructing their own canals were of two minds as to the size of canal best suited to American needs. On the one hand, those who preferred to construct canals with narrow locks pointed out that they were cheaper to build, used less water in operation (always a key consideration) and that the narrow boats were easier to track, faster, and caused less damage to the canal banks than the broad lock boats. The advocates of the broad locks, however, while recognizing that the narrow boats were of a sufficient size to economically transport heavy freight such as coal, stone, iron and diverse heavy minerals, maintained that narrow boats were too small to be economically viable for transporting in bulk items such as agricultural produce, light manufactured goods and merchandise, cotton and lumber. In consequence, the major American canals were constructed at this time with locks which corresponded either to the narrow or the broad lock, although generally slightly wider and longer depending on the size of the boat best suited to transport the type of cargo expected and/or the personal preference of the engineer in charge. For example, the recently completed Erie Canal (1825), as the Officers of the Board of Ordnance were well aware, was four feet deep with broad locks 15 feet wide and 90 feet long; whereas the Morris Canal (constructed 1824-31) on which work was progressing in New Jersey, was to have narrow locks 9 feet wide and 64 feet long on a four
foot deep navigation. The Board of Ordnance therefore would have received a good deal of support from contemporary American canal engineers for its stand that a canal with locks as large as those on the Lachine Canal, viz. 20 feet wide and 108 feet long with 4½ feet of water on the sills, could more than adequately serve the commercial needs of the Canadas. Indeed, at least one of the engineers on By's staff, John MacTaggart, was opposed to constructing locks any larger than the Lachine locks on the Rideau navigation.

MacTaggart was never convinced of the need to construct the large locks proposed by Lt. Col. By. To the contrary, he believed that the 20 foot wide lock would suffice to meet commercial transport needs, and maintained that it would pass both barges and timber rafts. (It is strange that MacTaggart should hold that timber rafts could pass the 20 foot lock when, as mentioned, the drams on the St. Lawrence River were 33 feet wide by 100 feet long. He may however, have been thinking in terms of breaking up the drams to pass through the locks, a costly and slow process which the timbermen wished to avoid even at the risk of running the rapids; or he may have counted on the timbermen changing the make-up and hence the size of their drams.) But more importantly, MacTaggart objected to building the large locks on the grounds that too many locks would be required to complete the Rideau navigation (presumably because the lift of the large locks would have to be reduced given the greatly increased water pressure that had to be dealt with); and he feared that it would prove difficult to open and close the gates on such a large lock (again presumably because of the water pressure). MacTaggart's fears on this subject, as well as the apprehensions expressed by Major General Smyth whose comments By had yet to receive, could not have been lightly dismissed by Lt. Col. By as the 50 or more large locks that he proposed to build were of a stupendous size: 50 feet wide by 150 feet long with 10 feet of water on the sills.
The largest canal locks by far to be constructed in Britain or North America to that date were those built by Thomas Telford on the Caledonian Canal in Scotland. When opened in October 1822, it had locks 40 feet wide and from 170 to 180 feet long on a projected 20 foot deep ship canal which was intended to enable 32 gun frigates and ships of 1,000 tons burthen, then the largest employed in the Baltic trade, to pass from the North Sea to the Atlantic Ocean. But Telford's locks were "of unusually large dimensions"; and there was some contemporary criticism to the effect that they were too large to serve any practical purpose. Moreover, it had taken 19 years to construct the 28 locks on that 60 mile long navigation at a cost of £986,924. In North America, nothing comparable had been contemplated let alone constructed. Even the Welland Canal, which was being built to pass the largest sailing ships then navigating the Great Lakes, schooners from 90 to 120 tons burthen, was to have locks 22 feet wide and 110 long on a canal with an 8 foot depth of water. Nonetheless, By remained convinced of the necessity and practicability of the exceptionally large lock, and of his ability to build it. Consequently, he continued to press for its adoption.

Shortly after selecting the valley at Sleigh (or Rafting) Bay on the Ottawa River as the entrance to the projected Rideau Canal and putting men to work clearing and grubbing the land, Lt. Col. By addressed a report, 1 October 1826, to the Board of Ordnance in which he put forth an additional argument in favour of constructing large locks capable of passing steamboats, and in so doing inadvertently answered one of the major objections that Major General Smyth and the Duke of Wellington had raised in rejecting By's proposed steamboat navigation. In sum, By pointed out that there would be no difficulty in operating steamboats on the Rideau navigation as almost 100 miles of that projected 123 mile waterway consisted of either lakes or wide rivers.
with strong natural banks; and that the use of steamboats would eliminate the need, and hence the expense, of constructing towpaths along that part of the navigation. Moreover, By added that he hoped the Master General and Board of Ordnance would reach a decision on the question of building the large locks before the spring of 1827 when he proposed to commence the masonry of the first 8 locks in the Entrance Valley. The Board, of course, had already made a decision as he was soon to find out, and was to reconfirm that decision months later when it received By's report of 1 October. In the interim, By pushed on the work in keeping with his original instructions. The Entrance Valley was cleared and surveyed, two wharves and several service buildings were contracted out, and work commenced on the first span of the planned Chaudière bridge communication which was intended to facilitate the movement of food and supplies across the Ottawa River from the settlement of Hull to the Rideau establishment in the wilderness. Then leaving MacTaggart in charge of a survey party to map the projected line of the canal between the newly selected Entrance Valley and the proposed junction with the Rideau River in the interior, By returned to Montreal on 22 November 1826 to prepare plans, specifications and contracts for the locks required in the Entrance Valley. At Montreal, he received the package containing the Board of Ordnance's response to his 13 July report in which he had first advocated the construction of a steamboat navigation with large locks.

By's first reaction was one of hurt and dismay that Major General Smyth, as implied in his comments on the steamboat proposal, should think that he was ignorant of the fact that steamboats could not operate on canals. To the contrary, By responded on 6 December 1826, that he had never intended that the steamboats should work their paddles in the canal. The proposed navigation from Quebec to the Great Lakes, he added, consisted for the most part of wide rivers
and chains of lakes with only short sections of canal required in between. On the whole of the distance from Quebec to Grenville, some 340 miles, there would be only 2 miles of canal at Montreal, north of the island, where steamboats would have to be towed. Similarly, on the Ottawa River there would be only 12 miles of canal in a distance of 60 miles, and only 20 miles in total of short artificial cuts on the 123 mile long Rideau navigation. Moreover, steamboats were much better adapted to operating on the wide rivers and lakes of such a system than the schooners and sloops which were "rapidly falling into disuse" in the face of steamboat competition. So convinced was By of the overwhelming advantage of a steamboat navigation that he had discussed, as he now reported, with several knowledgeable individuals whether steamboats might not be built to an altered design and configuration to reduce their width and draught sufficiently to enable them to be towed through the 20 foot locks while at the same time retaining their sea worthiness for service on the lakes. More specifically, he had investigated the practicability of building sternwheelers with the paddles positioned on each side of the rudder and the engine moved "as far aft as possible".89 (It should be noted that almost all of the steamboats in use at that time were sidewheelers. Several sternwheelers on a comparatively small scale had been built at an early date in Britain; but there were structural problems in constructing sternwheelers of great hull length, involving the altering of the position of the engine as required in a sternwheeler, which were not overcome until the introduction of hogging chains during the 1830s-1840s. Large sternwheeler steamboats consequently did not appear in significant numbers on American rivers until after the American Civil War.90) To By's mind the use of steamboats was essential to the effective defence of the Canadas; and to that end, he was clearly prepared to follow up all possibilities to ensure that steamboats could operate
on the 20 foot canal that he had been ordered to build. Nonetheless, he continued to press for the construction of the large locks, but with several major modifications.

In the face of the Board's complete rejection of his steamboat navigation proposal, Lt. Col. By re-examined all of its implications and tried to save what he could. Having answered the Board's technical arguments against a steamboat navigation, By appears to have realized that the projected cost of his scheme for a series of steamboat canals, £1,200,000 or more, was far beyond anything the Board of Ordnance could ever accept. After some study, he concluded that both the sweep and the scale, in at least one dimension, of his large lock canal system could be reduced while still retaining the essence of it and the possibility of future improvement. Drawing on his observations of the commercial navigation system as it operated on the St. Lawrence River, By sought to explain in the second part of his 6 December 1826 reply to the Board, why he believed it was essential that the large locks be constructed at least on the Rideau navigation.

The trade of the interior Great Lakes region, as By explained in some detail, was carried down the St. Lawrence River by means of a variety of craft: scows, rafts, Durham boats and steamboats. The down trade consisted for the most part of flour, potash, and staves loaded on scows, and timber rafts which were floated downstream in groups of 5 or 6 accompanied by a single Durham boat. Steamboats stationed along the route were used to tow the rafts and scows over the stretches of still water and across the lakes. At the rapids, the scows and rafts were shot through, and the Durham boats followed or, at the worst rapids where canals had been built, resorted to the canals. At that time, there were three short military canals on the St. Lawrence River, each consisting of a canal cut in the river bank with from one to three locks: viz. at the Coteau du Lac, the Cedars, and the Cascades rapids, respectively, as well, of
course, as the Lachine Canal at Montreal. The military canals were on the river section between Lake St. Francis and Lake St. Louis just upstream of the junction of the Ottawa and St. Lawrence rivers, and were originally constructed, 1779-1783, to serve batteaux and canoes. They had, however, been enlarged several times since then by the Royal Engineers and by 1817 were capable of handling Durham boats. The locks were 12'-6" wide at the gates with lock chambers 20 feet wide by 120 feet long with 3½ feet of water on the sills. Once at Quebec, the scows and timber rafts were taken apart and sold along with their loads, and the merchandise purchased was carried back up river in the Durham boat. The existing transport system, however, was not only vulnerable to stoppage by the Americans in time of war, as everyone was well aware, but also as By now pointed out, in peacetime which in his view necessitated the Rideau Canal being designed so as to be able to handle the commercial traffic of the St. Lawrence River.

In the peace settlement made following the close of the War of 1812, the British negotiators, through "a deplorable oversight", had acquiesced in American claims to Barnhart's Island in the St. Lawrence River near Cornwall, and in consequence had given the Americans complete control over the only navigable channel on the river. The Americans, By argued, were thus in a position to levy heavy transit duties on Canadian trade, or stop it altogether as a means of forcing the British government to grant American ships the right of free passage down the St. Lawrence. Either recourse would defeat By's purpose as he envisaged his canal system not only capturing the trade of the North American interior for the St. Lawrence outlet; but carrying that trade in British ships which consequently would enjoy a vast superiority in numbers over American shipping when put to military use in time of war. To circumvent the Americans therefore, and deprive them of their newly gained advantage, it was necessary, as By explained, that the Rideau Canal be
constructed so as to be able to serve as an alternate trade route with sufficiently large locks to prevent the Rideau being a bottleneck on the system.\textsuperscript{94}

The merchants with whom By conferred had complained that the 20 by 108 foot locks were too narrow and short to handle the commerce of the St. Lawrence; but they had no objections to the 5 foot depth of the Lachine Canal. In taking this into account, By argued that he would be neglecting his duty if he "did not venture strongly to recommend" that the large locks, 50 feet by 150 feet be constructed on the Rideau, but with only a 5 foot depth instead of the 10 foot depth previously recommended. This would meet the needs of the timber trade and the increasing demands of the St. Lawrence trading system as well as serve to thwart the designs of the Americans with only a minimal increase in cost. He projected that it would add only about £50,000 to the engineering estimate then in preparation as the expense of much of the work, as for example the forming of coffer dams, constructing the dams and embankments, the surveying and clearing of the land, and even the thickness of the masonry of the locks, would not be altered in building large locks with the same lift as the respective small locks. Moreover, only the Rideau Canal system had to be built with the large locks at the present time, as the scows and rafts could be shot through the rapids on the Ottawa River as they were already on the St. Lawrence, and the 20 foot wide locks under construction at Grenville would suffice to pass the Durham boats.\textsuperscript{95} (By did not explain why the rafts and scows would not be able to pass through the rapids of the Rideau system, but the reason was obvious. Once the Rideau Canal was constructed, its configuration was such as to prevent rafts and scows by-passing the locks. Unlike the St. Lawrence and Ottawa River canals, which were basically canal cuts made in the river bank to pass around the rapids, the Rideau Canal was to consist of high dams built across the river to flood out the rapids, with locks
adjacent to each dam to pass the boats. If the locks therefore were not sufficiently large to pass the scows and rafts, the latter would be unable to pass at all.)

In restricting his large lock proposal to the Rideau Canal at this point, By was trying to meet the cost objections of the Board of Ordnance while leaving open the possibility of the other canals being enlarged at some future date, and ensuring that the Rideau Canal, if he received authorization to construct the large lock, would continue to be an integral and adequate link in the commercial navigation system of the Canadas. Nonetheless, he assured his superiors that he was proceeding to plan and construct the Rideau Canal in strict accordance with his instructions, as indeed he was; and that he would build the canal within four years regardless of the size of lock ultimately adopted. He expressed "great doubts", however as to whether the Rideau Canal could be constructed even with the 20 foot locks in keeping with the £169,000 estimate, but declared that he would reserve his judgement until he had completed his first tour of the canal route in the spring of 1827. At this point all correspondence on the subject of the large lock question ceased as By, while awaiting further comment from the Board of Ordnance, concentrated during the winter of 1826-27 on preparing plans, specifications and contracts for the work required on the first eight miles of the canal.

In retrospect, it is clear that Lt. Col. By had arrived at a sound judgement in advocating that locks 50 feet by 150 feet with 10 feet of water on the sills would be required to handle the vast and rapidly increasing trade of the St. Lawrence. In little more than a decade after the completion of the Rideau Canal in 1832, work commenced on the enlargement of the Lachine Canal at a time when the St. Lawrence navigation route was filled to capacity with shipments of wheat and flour. The new Lachine Canal locks, completed in 1848, were 45 feet wide by 200 feet long with 9
feet of water on the sills; and they were adopted as the standard for all of the other locks constructed on the various canals built on the upper St. Lawrence River (the Beauharnois, the Cornwall, and the Williamsburg canals), during the period 1842-48. In view of these later developments on the St. Lawrence River, however, it appears extremely doubtful, despite By's expressed hopes to the contrary, that the long circuitous Rideau navigation system could ever have superseded the more direct St. Lawrence route; and this was even more the case if the large locks had been built with only 5 feet of water on the sills. But then again, the merchants of Montreal all along had favoured improving the St. Lawrence River navigation rather than the building of the Rideau Canal; and that was why the British government, which desired the canal to be constructed for military reasons, had had to undertake the construction of the Rideau navigation without any expectation of financial aid from the provinces. Lt. Col. By was well aware of that fact, as was Major General Carmichael Smyth; and from the commercial arguments advanced in favour of the large lock, it is evident that he believed the Rideau Canal would convey the bulk of the trade of the interior only in the event of war and/or the Americans cutting off or imposing heavy levys on Canadian trade passing down the more direct upper St. Lawrence River route. Be that as it may, By's later arguments show that his primary motivation in advocating the large lock size was, and remained, military. The large locks were essential to the strategic defence of the Canadas as he envisaged it; and the commercial arguments were used to buttress what was required on military grounds.

During the 1827 working season, May to November, Lt. Col. By and his staff concentrated their efforts on completing the survey and levelling of the Rideau Canal route and preparing plans, specifications and contracts so that as much work as possible could be contracted out. As
of 7 July, working plans and sections were completed for the line of canal from the Entrance Valley to Long Island inclusive, and contracts had been let for all of the excavation and masonry work on that section of canal which when completed would render roughly 40 miles of the canal navigable. Elsewhere, clearing and grubbing work was underway at most of the proposed locksites. Lock masonry work commenced with the laying of the foundation stone of the third lock in the Entrance Valley on 16 August; and by the end of September the masonry of the first three locks was progressing rapidly. In keeping with By's instructions, these locks were being constructed on the same scale as the Lachine and Grenville canals, viz. 20 feet wide by 108 feet long with 5 feet of water on the sills. Lt. Col. By made no further mention of the large lock controversy in the various progress reports forwarded to the Board of Ordnance during the summer; but he did present another argument in support of his contention that steamboats were indispensable.

Shortly after completing his first trip through the Rideau-Cataraqui waterway and back in May 1827, By reported that it would be impracticable to build towpaths on upwards of 70 miles of the proposed canal route. For that distance the banks consisted of either high rocky cliffs which would be costly to excavate or low lying flood plains requiring heavy embanking, or equally expensive, the building of timber pile and log causeways to serve as towpaths. Indeed, there was even some question whether the causeways, if built, could be maintained. Ice frozen to the piles of bridges was capable in time of flood of raising and destroying them, as By had witnessed when stationed at Montreal in the spring of 1806; and on the Rideau system where flood waters rose from 13 to 15 feet, he believed it was "more than probable" the piles of the causeways would be raised and carried off. Towpaths were only feasible where the locks and canal cuts were located, some 20 miles
distance in total. A towpath could be constructed around the margin of some of the lakes; but this would double the distance. Moreover, poling directly across the lakes was out of the question as some were as much as 40 feet deep and the shallow lakes, five to six feet deep, had soft mud bottoms from 30 to 40 feet deep. Boats crossing the lakes therefore would have to resort to rowing or using their sails, in either case a tedious and slow passage at best. But steamboats, By continued, would answer all of the difficulties; and in conclusion, he requested permission to expend £2,500 in building a steamboat capable of passing through the 20 foot lock. This he intended to use on the summit level lakes to transport materials during the construction of the canal with the steamboat to be sold for potential use as a tow boat once the canal was completed. At this point, Lt. Col. By would seem to have acquiesced in MacTaggart's view that the 20 foot wide lock, with steam tugs stationed on the river and lake sections, was sufficient for the Rideau navigation, but such was not the case.

The last thing By wanted to do was to stop up with small locks what he regarded as a potentially "magnificent water navigation." On 4 October 1827, he informed the Board of Ordnance that his staff was busy preparing plans and estimates for the whole Rideau Canal project, together with an up-to-date record of financial disbursements, which would be sent to England for submission to Parliament as requested. When completed, he intended to forward them with an officer, Lt. Pooley, who it was hoped would be able to depart soon enough to catch the 8 November packet out of New York so as to arrive in England by mid-December. Pooley, it was explained, was going to be thoroughly briefed on By’s plans and taken through the whole of the Rideau Canal route prior to his departure, so that he might be aware of all of the advantages and arguments in favour of constructing the large lock. Once the Ordnance had studied
the plans and estimates, and questioned Lt. Pooley, By hoped that he would receive orders to build the large lock. Although work was proceeding rapidly on the masonry of three of the locks in the Entrance Valley, he calculated that only £3,000 would be lost, in work and materials, if the large lock were authorized. More generally, the work was progressing much more rapidly than By had anticipated; and he reported that in consequence he would require £100,000 per annum for disbursements on the spot. If a decision on the lock size were rendered without delay, By was confident that with the work progressing as it was, the canal construction project might well be completed as early as 12 August 1830.105

The report that By and his staff prepared, dated 1 November 1827, contained a series of plans comprising a plan view and section of each lock site, and an estimate for the work required at each, including contingencies.109 This was the first detailed engineering estimate prepared by Lt. Col. By for the Board of Ordnance. Earlier, on 6 December 1826, he had expressed grave doubts as to whether the canal could be constructed in keeping within the £169,000 estimate prepared by Major General Smyth from Samuel Clowe's survey and estimate of 1825,110 and had reported that if the Rideau Canal were to be constructed with the large locks, it would cost only £50,000 more than building the 20 foot wide Lachine locks whatever that might be determined to be.111 Now, he estimated that it would cost a total of £474,844.1.2 1/2 to build the Rideau Canal with the Lachine locks. By did not attempt to explain away the large increase on the original £169,000 estimate. He had furnished his estimates and that was that. However, once again he expressed his hope that he would soon receive orders to construct the large locks, and referred the Ordnance Board to his previous arguments to which he now affixed several additional comments. On the one hand, he pointed out that not only would the wake of the steamboats
not harm the river banks, scoured as they were by seasonal floods which raised the river from 13 to 15 feet, but even the canal cuts required were secure from injury as they would be made chiefly through rock. Moreover, the large lock would pass the large steamboats capable of navigating the lakes, as well as the spars, 120 to 130 feet long, destined for the Royal Navy. In conclusion, By referred again to his projected completion date of 12 August 1830, and reiterated that to realize this objective, he would require £100,000 per year for disbursement as construction advanced.112

Whether Lt. Col. By realized it or not, the reduction of the depth of the proposed large lock from 10 to 5 feet of water on the sills introduced several seemingly serious inconsistencies into his argument. He continued to hold that the large locks of reduced depth would pass steamboats sufficiently large to be seaworthy on the Great Lakes, and therefore would retain all of the advantages of the steamboat navigation needed to carry out his defence strategy. However, the reduction in depth would have excluded the large lake steamboats which drew 8 feet of water when fully loaded; although it would have passed the smaller river steamers operating on the Ottawa and upper St. Lawrence rivers. But in that case, there was no need, in terms of contemporary steamboat hull design, for the large dimensions of 50 by 150 feet as this was totally out of keeping with the size of steamboats having less than a 5 foot draught: viz. steamboats no more than 108 feet long by 30 feet wide clear of the paddles.113 Moreover, within a month of arguing that a 5 foot deep lock would pass steamboats of sufficient size to be seaworthy on the lakes, Lt. Col. By was to state that steamboats to be seaworthy on the lakes had to have a breadth of beam (clear of the paddles) of 46 to 48 feet (see below). However, he did not mention that steamboats of that breadth of beam, again given contemporary hull designs, would have drawn more than 5 feet
of water when fully loaded. A possible explanation for this seeming contradiction is that By intended the large lake steamboats to lighten their loads before entering the Rideau Canal. This was, and continued to be, a standard practice for deep draught vessels entering a canal; and if it were done with respect to the Rideau Canal, the large 150 by 50 foot locks with a 5 foot minimum depth could have passed all but the very largest of the lake steamboats when not fully loaded.

At this point, it appears that By was trying to salvage as much as he could of his large lock proposal; and he may well have been looking to the future for the full realization of his navigation scheme. This was definitely the case with respect to his belief that the other canals would be enlarged in future to match the Rideau Canal if it were built with the large locks. He may well have believed that if the large locks of reduced depth were built on the Rideau, the possibility remained that they might well be deepened at some future date in the event the Rideau system were to become established as the commercial export-import route for the trade of the Great Lakes basin as he hoped it would. On the other hand, far less creditable to By, he may have hoped that if the Board of Ordnance could once be brought to accept the limited increase in the estimate required to construct the large locks at a reduced depth, then additional arguments might be brought to bear in favour of increasing the depth. Whatever his motives and intentions, Lt. Col. By continued to argue that the proposed 150 by 50 foot lock of reduced depth would pass steamboats of sufficient size to navigate on the Great Lakes in keeping with the requirements of his defence strategy.

Lt. Pooley left for England with the plans and estimates on 26 October 1827, and Lt. Col. By and the rest of his staff remained at the Royal Engineers Office in the Entrance Valley where they prepared contracts and
specifications for the work at the lock sites that had not been contracted out in the spring of 1827. This work was completed by 3 December, and forwarded immediately to the Deputy Commissary General's Office in Montreal so that it could be advertised for tender up until the specified closing date for the bids on 1 February 1828. While the contracts and specifications were being prepared under his supervision, Lt. Col. By drafted a series of letters to his superiors in which he elaborated on his strategy of a mobile defence based on a large lock steamboat navigation, and added a new dimension to his military strategy. In so doing, By showed clearly that military considerations were, and remained, primary in motivating his advocacy of the large lock.

The Matured Military Strategy of Lt. Col. By
As the course of his correspondence, November 1827 through to January 1828, shows, Lt. Col. By continued to believe that the construction of an uninterrupted steamboat navigation from Quebec via the St. Lawrence, Ottawa and Rideau navigations into and through the Great Lakes was essential to the successful defence of the Canadas in the event of another conflict with the United States. Once this navigation system were constructed, together with a similar scale of navigation on the Richelieu River, By was convinced that Lakes Champlain, Ontario and Erie could be scowed with troops, which in conjunction with strong naval forces, could defeat any invasion force mounted by the Americans. He now calculated that with the increasing trade of the country there were already enough steamboats to transport an army of 20,000 men rapidly to any part on the projected system and more were being constructed. Indeed, in November 1827, By received a request from a private individual for permission to commence operating a steamboat in the spring of 1828 on the 27 mile stretch of stillwater between Long Island and Burritt's Rapids on the Rideau River; and By, of
course, was still anxious to receive authorization to build a steamboat for service on the Rideau lakes. Such a steamboat navigation, he re-iterated, would enable British merchants to sell their manufactured goods on the Great Lakes at half the cost of American manufactures, and would move the produce of the region down to Quebec through the Canadian canals in British vessels. However, it was essential to have the 50 foot wide lock as steamboats to be seaworthy on the Great Lakes had to have a great breadth of beam and were consequently 46 to 48 feet wide. (The steamboats then in use were sidewheelers; and the width figures given here were, of course, inclusive or clear of the paddles.) To this end, By continued to recommend that the Welland Canal, then under construction, be enlarged and equipped with 50 foot wide locks; and he was confident that the Grenville and Lachine canals, although not necessary to handle the down trade scows and timber rafts (as explained earlier) would be enlarged as they required repair rendering them ultimately suitable for military operations. The steamboat navigation system, as By continued to envisage it, would not only provide a rapid troop movement and deployment capability, but would give Britain control of the lakes which had long been regarded in military circles as being the key to the defence of the Canadas in any future war. Here, of course, By differed radically from the Duke of Wellington and Major General Smyth who had developed a purely military strategy of static defence based on interior canals on the grounds that the St. Lawrence River transport system, even with the addition of the Rideau and Ottawa River canals, was too slow and costly for British forces ever to be able to gain a naval supremacy on the lakes in any future shipbuilding race with the Americans. Lt. Col. By, however, believed that this was no longer the case, as his projected steamboat navigation would relieve the British government of the major problems experienced in conducting military and naval operations during the last war.
As Lt. Col. By was well aware, the British government had been embarrassed by the enormous expense and difficulties involved in moving ordnance and supplies from the ocean ports of Quebec and Montreal to Upper Canada during the War of 1812. One of the major motives for undertaking the construction of the Rideau Canal, as well as the Lachine and Ottawa River canals, was to provide a cheap, secure communications route through to the Great Lakes and Kingston in particular. Transport had been provided, as mentioned, by batteaux which took twelve days on the average to ascend the St. Lawrence River from the head of Montreal Island to Kingston while having had to contend with sporadic fire from the American side of the river as well as the necessity of labouriously portaging around the various rapids in the river. In 1815, it had cost £4 to £4.10 per ton to move supplies up river; and as much as £200 to transport a 24 pounder weighing 53 cwt. from Quebec to Kingston. Indeed, a warship built on Lake Ontario had required an outlay of upwards to £500,000 [sic] most of which was expended in transporting her stores, cables and guns from Montreal. By pointed out that if the Rideau Canal were constructed as a steamboat navigation, the 447 miles from Quebec to Kingston via the Ottawa and Rideau navigations, could be covered in 77 [sic] hours; and it would cost less than £5 to move a 24 pounder that distance utilizing the canal system then approaching completion: viz. 22 hours by steamboat from Quebec to Montreal, a distance of 180 miles; 3 hours from Montreal to Lachine by canal boat towed for 9 miles along the Lachine Canal; 8 hours from Lachine to Grenville some 60 miles by steamboat; 4 hours to pass through the 15 miles of Ottawa canals in a canal boat; 8 hours from the Grenville Canal 60 miles up river by steamboat to the Rideau Canal; and 25 hours to pass through the 123 mile long Rideau Canal to Kingston. Stores would cost no more than £1.3 per ton to transport; but the speed of transit could only be realized if steamboats were
operated on the Rideau Canal where the impracticability of constructing towpaths for upwards of 70 miles of its length rendered sailing ships subject to long delays in the face of contrary winds. Although Lt. Col. By must have realized that the arguments he advanced as to the savings in transport costs which would accrue from constructing a large lock steamboat navigation would apply equally well to a navigation equipped with 20 foot wide locks and steam tugs, he nonetheless expounded on this aspect as he knew it would appeal to the Board of Ordnance and Major General Carmichael Smyth in particular. Moreover, in seeking to respond to the concerns of the Ordnance Board, By was led to develop a new dimension to his military strategy which ultimately provided him with an additional argument in favour of constructing the 50 foot wide locks on the Rideau Canal.

In November 1827, Lord Dalhousie, the Governor General and Commander-in-Chief of His Majesty's Forces in British North America, confided to Lt. Col. By that the Board of Ordnance was considering the possibility of casting heavy ordnance, such as iron guns and shot, at Canadian foundries as a means of reducing the horrendous transport costs of the last war. Indeed, the Board of Ordnance was then in the process of gathering information on Canadian iron foundries. Officers were sent out from Kingston, and presumably Montreal, with instructions to examine and report on existing foundries as to their production capacity and capabilities, the quality, quantity and availability of raw materials, as well as their products, prices and transport facilities. At this time, there were two foundries in operation in the Canadas: the St. Maurice Iron Works on the St. Maurice River 8 miles upstream of Trois Rivières; and the Marmora Iron Works on a branch of the Trent River some 30 miles inland from Belleville on Lake Ontario. In addition, there were two known sites with extensive iron ore deposits: at Gananoque near Kingston; and in the Gatineau Hills near Hull. The latter deposits, in particular,
had already attracted the attention of the men working on the Rideau Canal construction project.

For several decades before work commenced on the Rideau Canal project, it was known that there were extensive deposits of high grade iron ore in the Hull area.\(^{132}\) No sooner had Lt. Col. By and his staff arrived in Hull in the fall of 1826 to commence work on the Rideau Canal than John MacTaggart in company with Philemon Wright and Thomas McKay set out to explore the surrounding area. They succeeded in discovering a rich ore bed close to the Gatineau River in an area well covered with hardwood, mostly maple which was considered ideal for making charcoal, and blessed with an abundance of water power nearby at the first falls of the Gatineau River some 2 miles from its junction with the Ottawa. MacTaggart, for one, believed that it was the best place possible for an iron foundry;\(^{133}\) and he, together with Wright and McKay, had formed the "Hull Mining Company" in the hope of establishing an iron works to supply the iron work required for the Rideau Canal project. This promising beginning, however, was not followed up as English flat iron and castings from the St. Maurice Iron Works were readily available in Montreal.\(^{134}\) Nonetheless, Lt. Col. By was well aware of the potential of the Gatineau iron ore deposits as is indicated by his response to Lord Dalhousie's missive even though he did not share MacTaggart's enthusiasm for the immediate establishment of an iron foundry there.

Lt. Col. By recommended to Lord Dalhousie that the British government should concentrate immediately on developing the Marmora Iron Works. He was convinced that a navigable waterway would eventually be established (as it eventually was)\(^{135}\) from the Bay of Quinte, on Lake Ontario through the Trent River-interior lakes system to Lake Simcoe and beyond to Lake Huron. This would provide a cheap transport system for the products of the iron foundry, thereby rendering that enterprise of inestimable value, as well as foster a rapid settlement of the extensive area
along the waterway. The area around the Gatineau River, near its junction with the Ottawa some three miles below the entrance to the Rideau Canal, was as By explained, rich in fine iron, copper and plumbago and ideally situated for the establishment of foundries capable of casting guns for the government. However, he was of the opinion that the canals under construction when completed would enable guns and heavy ordnance to be shipped sufficiently quickly and cheaply from existing foundries for use on the Bytown-Kingston sector and the Great Lakes as to negate any need for expending large sums on establishing an iron works on the Gatineau. Nonetheless, By did recommend the construction of extensive works on the Ottawa River, which if carried out would have modified extensively the role of Kingston in the defence of Upper Canada.

In Wellington's strategy for the defence of Upper Canada the Rideau Canal, in conjunction with the Ottawa and Lachine canals, was intended to provide a secure and relatively cheap mode of interior communications for the transport of troops, ordnance and supplies and the circulation of gunboats between the port of Montreal and Kingston on Lake Ontario. Kingston was regarded as "the key to Upper Canada." It not only sat astride the communications routes with Lower Canada, whether via the St. Lawrence River or the Rideau system, but was the principal depot for military and naval stores intended for the defence of Upper Canada as well as the site of a large dock yard for fitting out warships for service on the lakes. To strengthen that position, the Royal Engineers were engaged, simultaneously with the construction of the Rideau Canal though under a separate command, in preparing plans for building a number of permanent fortifications at Kingston (Fort Henry was constructed 1832-36) to be garrisoned with a detachment of 600 men. Lt. Col. By was perfectly in accord as to the strategic importance of Kingston, and the necessity of strengthening the fortifications there.
However, he believed that the Kingston naval and military arsenals and the dockyard were in too exposed a position close to the American frontier. In the dockyard, in his estimation, there was almost £1,000,000 of stores; and in the event of hostilities commencing, the first move of the Americans would be to cross the river and attempt to destroy them. A few well-aimed shells would suffice to do this; and once accomplished, it would severely hamper British naval operations on the lakes. Therefore, By proposed that the great naval and ordnance arsenals and the dockyard for the construction of naval vessels for service on the Great Lakes should be established at the mouth of the Rideau Canal on the Ottawa River. This was a natural defensive position surrounded by high rocky cliffs which could be heavily fortified at moderate expense, and was situated some 133 miles from the frontier from which it was separated by a large tract of virtually impenetrable wilderness.

Moreover, Commodore Barrie, the Commander of His Majesty's naval forces on the Great Lakes, was soon to assure By that frigates of the size required for action on the Great Lakes could be towed through the 50 foot by 150 foot lock with a 5 foot depth of water. Here again, however, the size of the locks to be built was the critical concern; and By's actions show beyond a doubt that military considerations were paramount in his thinking.

Initially By was informed that in Commodore Barrie's view the large 50 foot lock would have to have a seven foot depth of water to meet the needs of the naval forces operating on the lakes; and he had written directly to Major General Carmichael Smyth, 10 December 1827, informing him of the need to construct the large lock of that depth and explaining how the additional two foot depth might be attained with a moderate increase in expenditure. But once By had occasion to explain the details of his plans and the costs involved to Commodore Barrie, the latter offered that vessels requiring 7
feet of water could be towed "on an even keel" through the large lock if it were built with only a 5 foot depth of water. (This was, of course, if the frigates were stripped of their guns, and perhaps their ballast.) Thereupon, By immediately reverted back to his original large lock proposal and informed the Board of the change in his thinking. At this point, 23 January 1828, Lt. Col. By had developed in full the military strategy which demanded the construction of the large 50 by 150 foot locks on the Rideau Canal: viz. an offensively oriented strategy of a flexible defence in depth based on secure interior lines of communication and supply between strongly fortified key positions, the building of warships and the manufacture of heavy ordnance and munitions in the interior, and a superior mobility provided by armed steamboats which would enable British troops to make rapid, concentrated strikes in force at any point on the frontier to meet or forestall American invasion attempts.

Lt. Col. By, however, was not advocating that large scale offensive operations should be launched across the Great Lakes into the hinterland of the United States in a future war. He appears to have been in accord with Wellington who held that the nature of the terrain, and the lack of extensive heavy areas of settlement on the American Great Lakes frontier, would make it impossible to supply a large army in the field once it quitted the lakes, and that such an army no matter where it might march could not sufficiently injure the Americans in any way so as to force a conclusion to the war. Granted the Erie Canal had been constructed since Wellington gave his opinion in February 1819 and American settlement was spreading rapidly into the Great Lakes basin following the close of the War of 1812; but Wellington continued to hold to his view with respect to the futility of offensive operations in that sector. That appears also to have been the case with Lt. Col. By as he did not comment in any way as to how the
troops were to be supplied in the field once they got beyond the range of the steamboats on the lakes; and he did not discuss offensive operations being mounted in any context other than that of meeting an American force grouping to attack the Canadas. Both strategies, that of Wellington and that of Lt. Col. By, were basically defensive; but By's provided for hitting out quickly to meet and destroy American forces in the field before they crossed or as they crossed the border as opposed to Wellington who relied on impregnable fortresses to withstand a siege and on a capacity to move troops there within several days to raise the siege, presumably by attacking the investing forces in the rear.

Everything, of course, depended on the response of the Board of Ordnance to the plans and estimates which Lt. Pooley was conveying to England. In company with Captains Savage and Victor, Lt. Col. By completed a tour of inspection of the Rideau Canal route between January 7th and 17th, 1828, and reported that the contractors were busy making arrangements for the commencement of the coming work season and everything was "proceeding with a rapidity far exceeding our most sanguine expectations". While stressing that the work was being carried out in strict accordance with his instructions, By nonetheless repeated that there was still time to enlarge the 20 foot locks with but little loss of work or materials. On a more personal note, he stressed that he had "no other motive in thus strongly recommending the large lock, but the good of my Country"; and in the same vein, confided to Commodore Barrie that it would be "an act of madness" to build the small locks and deprive Great Britain of the strategic advantages of a steamboat navigation large enough to pass seaworthy vessels for service on the lakes. At this stage, however, there was little that Lt. Col. By could do to further influence the question one way or the other.
Escalating Estimates and Expenditures

The Reaction to By's November 1827 Rideau Canal estimate
Judging from the support received by an anonymous pamphlet which had been circulating among the ministers of the government and members of Parliament in London since September 1827, By's arguments in favour of a steamboat navigation had already won widespread support; but the large lock proposal was viewed with suspicion.¹ The pamphlet, which no doubt reflected the matured views of Major General Carmichael Smyth if indeed it were not written by him,² contended that if the Rideau Canal were built with the 20 foot wide lock and steamboats employed on the lakes and river sections to tow smaller vessels and carry goods as was the practice on the lakes of the St. Lawrence navigation, it would suffice to meet all of the needs of canal users for several generations. The large locks, it was admitted, would be even more advantageous; but only if the whole system of canals from Montreal to Kingston were equipped with the large locks. Here doubts were expressed as to whether a construction project on such a massive scale could ever be completed, and whether the Rideau Canal, dependent as it was on relatively small lakes for its summit reservoir, would have sufficient water to operate the huge 50 foot locks in view of the heavy traffic it was expected to handle. The projected cost, however, was the telling factor. Detailed calculations were furnished in support of an argument that, although a 20 foot wide lock canal from the Ottawa to Kingston would cost £169,000, it would cost as much as £804,000 to complete a canal system with the large locks from Montreal through to Kingston inclusive, if indeed
it could be done. This, it was maintained was a prohibitive sum far beyond what any government could "expect or dream" of asking from Parliament. In an era when financial restraint was the order of the day in keeping public accounts and conducting public enterprises, such an argument did not bode well for By's large lock proposal or for his estimates which grossly exceeded what had been submitted previously to Parliament. The arguments both for and against a large lock steamboat navigation, however, were quickly lost sight of in the initial reaction of the Ordnance to Lt. Col. By's estimates.

From the inception of the Rideau Canal project, the Master General and the Board of Ordnance had accepted without question the cost estimate submitted by Major General Carmichael Smyth in his report on the defences of British North America, dated 9 September 1825, and thereafter in all communications with successive governments had adhered to the Smyth estimate. On first approaching the government of Lord Liverpool for funds in January 1826 through the Colonial Department, the Ordnance had stated that the Rideau Canal project would cost £169,000 in total and suggested that £10,000 to £18,000 should be requested from Parliament for commencing and carrying on the work during the year 1826. The government had pared the request down to £5,000 which was subsequently voted by Parliament. In December 1826, the Board had requested and thereafter received a vote of £41,000 to carry on the works on the Rideau in 1827. This figure was based on the preliminary estimate of Carmichael Smyth minus the £5,000 voted in 1826, with the remaining sum averaged over the four years of the project. The appropriation required for 1828 was to be based on Lt. Col. By's engineering estimate, which he had assured the Ordnance would arrive in England about mid-December. This assurance had been received on 30 November 1827 in a letter in which By mentioned also that in view of the rapidity with which the work was progressing, he
would require £100,000 per annum for disbursements on the spot over a period of at least four years. However, the figure cited, the first indication of the potential magnitude of the cost of the Rideau project, had not had a serious impact on the Ordnance. In passing the letter on to the Master General and Board, General Mann the Inspector General of Fortifications had commented:

The statement held out that £100,000 per annum will be required is also so general, and so little in accordant with the Estimates upon which the proceedings have as yet been ordered, that I can form no correct opinion of what is meant, and therefore will forebear any further observations until the promised report arrives.

The Ordnance then could not but have been severely jolted when Lt. Pooley arrived on 7 December with Lt. Col. By's detailed estimates in which it was set forth that £474,844.1.2 1/2 would be required to complete the Rideau Canal with 20 foot wide locks, and somewhat more for the large 50 foot locks of 5 foot depth By advocated. This was all the more so, as Lt. Col. By's plans and estimates were submitted to the Master General, the Marquis of Anglesey, on 11 December together with a letter received the previous day from the office of William Huskisson, the Colonial Secretary, requesting the Ordnance to submit its Rideau estimates for 1828. Huskisson demanded that the Ordnance prepare a detailed report on the progress of the Rideau Canal project comparing the money expended to date with the work completed as a means of ascertaining whether the £169,000 which Parliament had agreed to grant in annual instalments would be sufficient for its completion. Moreover, it was made clear that Huskisson "would be extremely unwilling" to request additional grants from Parliament for the Rideau project beyond the original estimate, and indeed, wished to make a
good impression on that body when the 1828 estimates were submitted for the voting of the annual Rideau appropriation:

Mr. Huskisson feels that it would be superfluous to urge upon the Board of Ordnance the necessity of enforcing on the part of the Officers under their orders, the strictest economy, consistent with the usefulness and durability of the Works, but he suggests the propriety of being furnished with the minutest details of the expence [sic] already incurred, in order to be able to prove that the sum expended has been carefully and judiciously applied to the purposes for which it was voted.12

Although placed in a somewhat embarrassing position as to the amount of the estimate which would have to be conveyed to Huskisson, the Ordnance nonetheless was confident that his demands could be met with little difficulty.

From the very beginning of the Rideau Canal project, the Ordnance had been impressed by the zeal shown by Lt. Col. By in pushing on the work, the consequent rapid progress being made, and the evidence of his ability to economize in his expenditures. In particular, the quality of the masonry work completed to date and the low rate at which it had been contracted out had made a strong impression. The "very extraordinary discrepancy" between By's estimate and that of Major General Smyth's report of 1825 was noted, and no doubt deeply regretted; but it was accepted. This after all was a regular, detailed survey carried out by a highly competent Officer of engineers as opposed to the Smyth estimate which had been based on a mere preliminary survey; and Clowes' survey had not included any provision for contingencies or for the cost of housing and maintaining a military establishment. In taking account of these circumstances, General Mann proceeded with all due confidence to comply with the Master General's instructions
to prepare a response to Huskisson's demands.\textsuperscript{13} Lt. Col. By's plans and estimates, together with an abstract of the same prepared by General Mann and an up-to-date progress report drafted by Lt. Pooley, were conveyed to the Master General\textsuperscript{14} and forwarded to the Colonial Secretary on 18 December 1827.\textsuperscript{15} Lt. Pooley's report in particular, explained in detail the progress of the works under construction and noted further that £32,621.13.5 1/4 had been expended to date and that all of the remaining works were to be contracted out in time for work to commence on them in the spring of 1828.\textsuperscript{16} In sum, all but one of Huskisson's demands were duly met as General Mann pointed out that it was not possible to compare the ratio of work completed and monies expended to the total amount of work required as a check on the estimate. There were too many contingencies which could not be calculated; but he added that there was no reason to doubt either By's estimate or that the work would be carried on with all due economy.\textsuperscript{17} A more thorough examination of By's plans and estimates, however, was desired by the Master General who subsequently ordered a committee of engineers to be formed for that purpose.\textsuperscript{18} Whatever the original intent in forming the committee, the task at hand soon took on a different complexion as a serious charge was levelled against Lt. Col. By.

The former Master General of the Ordnance, the Duke of Wellington, submitted a memorandum on 29 December 1827 in which he approved of the decision to establish a Committee of Engineers to examine By's estimates, but declared that a much more wide ranging inquiry was required as he was of the opinion:

that Lieut. Colonel By ha[d] lost sight entirely of the Plan and Estimates for the Work having the same object in view which the late Master General and Board contemplated when they ordered Lt. Colonel By to execute this service.\textsuperscript{173}
It was possible, he allowed, that Lt. Col. By was right, that the original plan of excavating canal cuts around the rapids may well have been impracticable and the estimates erroneous; but this was something that the committee should determine. Moreover, it should examine By's plans in detail to determine if they were practicable, particularly with respect to his scheme of constructing high dams to flood out the rapids, and give an opinion on the cost of constructing a navigation in keeping with his plans. If it were ascertained that only By's plan was practicable, and/or that the original plan would have cost much more to execute than By's scheme, then:

their [sic] will remain only the regret that Lt. Colonel By should have taken upon himself to depart entirely from the Plan which had been in contemplation without giving any notice whatever till this moment, either to the late or the present Bd. of Ordnance.20

This was a potentially explosive criticism; and in retrospect one which makes it clear that Lt. Col. By erred badly in his initial communications with the Ordnance. In various reports, he had persisted in marshalling strategic and commercial arguments in favour of his recommendations that the Rideau Canal should be constructed as a steamboat navigation with large locks, and included these arguments along with his comments on the progress being made on the works and the costs being incurred. In several missives, By had expressed his belief that the £169,000 preliminary estimate for the project was totally inadequate; but at no time had he subjected that estimate, and the plan of construction on which it was based, to any detailed examination for the benefit of the Ordnance. When Lt. Col. By's plan and £474,844 estimate arrived at the Ordnance in December 1827, General Mann who had studied the Rideau Canal progress reports in detail and was personally acquainted with Lt. Col. By's abilities, was able to grasp the full
impact of what Lt. Col. By was in the process of accomplishing on the Rideau and the savings being effected. Therefore, he had no hesitation in accepting the augmented estimate and plans over that of the preliminary estimate prepared by Major General Smyth 1825 on the basis of Samuel Clowes' survey and plan of construction. However, to anyone reading Lt. Col. By's reports specifically to assess the relative merits of Lt. Col. By's estimate and plan of construction as opposed to the preliminary estimate and initial plan of construction, there was no compelling evidence to prove Lt. Col. By's plan and estimate were necessarily more reliable and/or feasible. Moreover, Lt. Col. By submitted an estimate far in excess of the preliminary estimate for the project and his plan of construction indicated that he intended to substitute a slackwater configuration of canal, where dams and locks were made use of to flood out and overcome rapids, in place of the more conventional approach of using canal cuts and locks to by-pass river rapids despite the fact that he had been instructed to build the Rideau Canal in keeping with the more conventional canal cuts/locks system as layed out in Samuel Clowes' report. A simple reading of Lt. Col. By's reports, as indicated by Wellington's remarks, left the impression that he had taken it upon himself to disregard his orders and substitute a different plan of construction for no apparent reason and perhaps at a far greater cost. From Wellington's viewpoint, there was as yet no compelling evidence in hand to prove that the authorized plan of construction was impracticable or that the preliminary estimate for its construction was totally inadequate. Clearly Lt. Col. By in his enthusiasm to convince the Ordnance to authorize the construction of the Rideau Canal as a large lock steamboat navigation had failed to adequately explain why he had rejected the initial plan of construction and estimate.
A good deal of confusion over the reliability of the £169,000 preliminary estimate, both on the part of the Ordnance in December 1827 and By's critics at a later date, could have been avoided if he had approached the lock size question in two stages. In the first instance, By should have explained to the Ordnance why the Clowes' plan of constructing the Rideau Canal by means of canal cuts would be prohibitively expensive, as he had determined it would be, and taken the time to prepare a cost estimate for the same; and then he could have recommended his slackwater navigation plan as a practicable and far less costly alternative. Once the Ordnance had realized that the Clowes plan of construction was not feasible because of the enormous cost involved and had approved a change in the configuration of the canal, then Lt. Col. By could have proceeded to argue on strategic and commercial grounds that the locks should be constructed on a larger scale to accommodate steamboats. At that point, he could have emphasized that with the new configuration of canal it was possible to increase the dimensions of the locks at minimal extra expense so long as the depth remained the same. The failure, however, of Lt. Col. By to approach the lock size question in two stages, or at least to make a clear distinction between the change required in the configuration of the canal on the grounds of cost and his recommended enlargement of the canal on military and commercial grounds, obscured the true reason for Lt. Col. By's decision to adopt the slackwater plan of construction and the inadequacy of the preliminary estimate. This confusion accounts for Wellington's demand that a committee of Royal Engineers be appointed in London to examine into the practicability and projected cost of the authorized plan as compared to the plan and estimate prepared by Lt. Col. By for his proposed slackwater navigation; as well Wellington's insistence that a second Committee of Engineers be sent to Canada to undertake an investigation on the spot and make
recommendations as to what course of action should be followed. To this end, he made quite specific recommendations.

To Wellington, and no doubt Major General Carmichael Smyth, the essential task of the committee proposed to be sent to Canada was to determine if the Rideau navigation could be constructed at a cost close to if not within the original estimate of £169,000, and if at all possible in keeping with the original plan. Thus, Wellington recommended that the Committee of engineers should go over the ground and compare in detail the plans of Lt. Col. By and the original plan as to their respective costs and practicability. If the original plan proved practicable and the cost estimate reasonably accurate, then the committee should be authorized to order Lt. Col. By to proceed on that plan, with the committee then turning their attention to ascertaining to what extent and at what cost the works already completed could be altered and incorporated into the original plan. If, on the other hand, the original plan was found to be impracticable or as costly as By's plan, and the latter were proved to be practicable, then the committee should order By to construct the canal as he planned. However, regardless of the plan to be followed, Wellington recommended that the expenditure for 1828 should not exceed £40,000; and that henceforth no contracts should be entered into until they were submitted to the government for approval along with a statement from the local authorities as to the prevailing price of labour and materials. It was further recommended that both committees should study carefully the contracts Lt. Col. By had entered into and investigate whether the various roads and bridges constructed had indeed resulted, as Lt. Col. By had claimed, in lower contract prices being obtained than would otherwise have been the case. Lastly, and most importantly, it was proposed that if the committee in Canada should determine that the Rideau Canal ought to be constructed in keeping
with Lt. Col. By's plan, then they should investigate the
cost and advantages that would entail if the locks were
increased in size. Henceforth, all of the Ordnance
decisions were made with the approval, if not at the
direction, of the Colonial Secretary and were strictly in
keeping with Wellington's recommendations.

Upon receipt of Lt. Col. By's plans and estimates in
mid-December, Huskisson had taken the position that the
government could not acquiesce in such an "alarming
increase" in the estimates over what had been previously
presented to Parliament "without the strictest scrutiny and
the dearest proof of necessity." This response no
doubt prompted the Master General's subsequent decision to
constitute a committee of engineers to examine By's plans
and estimates; but no action was taken at that time.
However, upon receipt of Wellington's memorandum swift
action ensued. On 1 January 1828, the Master General
ordered that a committee of engineers be established
immediately to examine and report on the plans and estimates
of Lt. Col. By; and the next day, Huskisson wrote to
Lord Dalhousie, the Governor General and Commander-in-Chief
of His Majesty's Forces in British North America, advising
him of that development, and adding that once the committee
submitted its report, a second committee would be
constituted to continue the investigation on the spot in
Canada. Furthermore, the Colonial Secretary informed
Dalhousie that orders were being sent to Lt. Col. By to
suspend all work which did not demand immediate execution;
and he requested that Dalhousie use whatever influence he
possessed to aid Lt. Col. By in persuading the contractors
to agree to the suspension of the contracts already in
force. Within days of this letter, Huskisson also
wrote to Lt. General, Sir James Kempt, the Lieutenant
Governor of Nova Scotia, explaining the steps that were
being taken, and requesting him to serve as president of the
engineering committee that would be sent to Canada.
virtually the same time, the Ordnance appointed a committee of inquiry to meet in London under the presidency of Major General Sir Alexander Bryce,27 and forwarded the work restraint order to Lt. Col. By.28 The Bryce Committee set to work immediately in keeping with their instructions which closely followed the points of inquiry recommended by the Duke of Wellington.29

The Bryce Committee Report of January 1828
The Bryce Committee report, submitted to the Ordnance 23 January 1828, completely exonerated Lt. Col. By as to his conduct and engineering decisions.30 In the first instance, the committee reported that Lt. Col. By had indeed deviated in a number of places from Clowes' line of canal which he had been instructed to follow; and that By had modified the approved configuration of the canal through substituting substantial high dams to flood out the rapids and form long stretches of still water in place of canal cuts around the rapids and a lesser number of low dams. Nonetheless, they concluded that in every instance where By had altered the approved line of canal, a substantial saving would be realized in construction costs; and that the high dams proposed for the navigation, although admittedly of an uncommon, even extreme height, appeared quite feasible and economical compared to the cost of the rock cutting which would have been required for the canal cuts. Overall, the committee found By's estimates and surveys "to have been framed with much care and accuracy"; and with the exception of several suggestions of a relatively minor nature, they were unable to recommend any alterations which would result in substantial savings. On the contrary, they were impressed that Lt. Col. By had managed to contract out the lock masonry work at the rate of 1s. 1 1/2d. per cu. ft. as this was about one-fifth less than the previously estimated rate, although they agreed with By's estimate that the cost of the masonry would probably increase to 1s.5d. per cu. ft.
for the locks in the interior where suitable rock quarries were not always close at hand. In the opinion of the committee By's lock design was the most economical that could be devised, in support of which they cited the proportionately much greater cost of the Lachine Canal locks. Indeed, the only expenditure they questioned was the £3,000 allotted for the building of the Chaudière bridges; and this, they allowed, may well have resulted in lower prices being received for the masonry work as Lt. Col. By contended. However, he had not submitted documentation in support of that contention. The estimates submitted by Lt. Col. By were another matter.

The committee explained that they were not surprised that Lt. Col. By's estimate greatly exceeded that of Samuel Clowes' on which Major General Smyth had based his £169,000 total estimate for the Rideau Canal project. They pointed out that Clowes' estimate was at best a rough calculation of what each proposed structure or cutting would cost rather than a detailed estimate, since Clowes had not prepared plans for any of the structures, or taken sections, or borings to determine the nature of the ground to be excavated. Moreover, Clowes had not allowed for contingencies in his estimate; whereas Lt. Col. By had included the customary one-tenth, viz. £42,862.18.10, in his estimate for that purpose. In sum although the committee commended Clowes for the skill and industry he had displayed in determining the best route for the general line of the canal, they concluded that his estimate was "quite inadequate", but understandably so. His report was "rather calculated to shew [sic] the practicability of the measure than to give an accurate calculation of the expense of effecting it." Consequently, they were convinced that Lt. Col. By had not lost sight of the original plan and estimate. To the contrary, he had adhered closely to the line of canal selected by Clowes, with the several deviations noted, and had carried on the work strictly in
keeping with the size of lock that he had been ordered to build. In defence of By's estimate, the committee noted that as early as 6 December 1826, Lt. Col. By had informed the Ordnance Board of his having "great doubts" whether the canal could be constructed for the £169,000 estimate; but that he could not offer a decided opinion until the whole route had been examined. In the opinion of the committee, Lt. Col. By had submitted his estimate as soon as could be reasonably expected:

it does not appear to us that detailed estimates founded on accurate measurements and levels could [have been] prepared and transmitted until the second summer.

In all areas of inquiry the Bryce Committee found Lt. Col. By's conduct and activities above reproach; and indeed, they commended him on his engineering decisions. They did not, however, share By's enthusiasm for constructing large locks on the Rideau Canal.

On the question of whether the Rideau Canal should be built with 20 foot locks as originally intended for the passage of gunboats, or constructed as an uninterrupted steamboat navigation with the large 50 by 150 by 5 foot deep locks advocated by Lt. Col. By, the committee expressed a somewhat ambivalent attitude based in large part on an evident reluctance to countenance increased expenditures on the part of the government. On the one hand, they saw no immediate advantage in constructing large locks on the Rideau navigation; but they were of the opinion that "great military advantages" would accrue if the provinces in future should have the financial resources to construct a large lock steamboat navigation from Quebec to Lake Ontario. The best solution that the committee could suggest was that since only eleven out of a total of 47 locks required for the Rideau Canal had been contracted out, the remaining 36 locks might be built of wood. This, they maintained, would not only save about one-third on the cost
of each lock, reducing the total estimate to £330,118.7.0, but would leave the question open for future resolution as the wooden locks could be easily enlarged at a later date. However, the committee qualified their recommendation almost to the point of revoking it by cautioning that "only weighty financial considerations would sanction the adoption of wooden locks." Major General Carmichael Smyth, who served as an ex-officio member of the committee, dissented from his fellow officers on this point in an addendum to their report.

Major General Carmichael Smyth reserved comment on the Bryce Committee report insofar as it pertained to Lt. Col. By's plans and estimates; but he firmly opposed the construction of wooden locks and dismissed the suggestion that an enlargement of the Rideau locks was a realistic proposition then or in the future. He maintained that there was no military advantage to be realized in constructing large locks on the Rideau Canal in the absence of similar locks on the other canals between Montreal and the Great Lakes; and the construction of such an extensive large scale navigation was, in his opinion, "too gigantic an undertaking ever seriously to be thought of." Consequently, he insisted that the Rideau Canal should be built with the 20 foot wide locks as originally planned, with the work proceeding possibly at a much slower rate in keeping with whatever annual appropriation the government should determine to provide for that service. Wooden locks should be resorted to only in an emergency, such as the outbreak of war, which would necessitate the rapid completion of the canal.

The Ordnance approved the Bryce Committee Report which was forwarded to the Colonial Department on 26 January 1828. The plans and estimates of Lt. Col. By, of course, had still to undergo a second examination by a committee of officers of engineers to be formed to investigate them on the spot in Canada; but in addition two major questions remained to be resolved: viz. what
expenditure was to be made on the Rideau project in 1828 and in succeeding years; and what size locks were to be built. At this juncture, the Ordnance deferred taking any further action until Huskisson's views should become known.\(^3^9\) The Bryce Committee had not commented on the first question believing it to be beyond their mandate,\(^4^0\) and the Master General and Board had likewise refrained from comment. However, Lord Anglesey did inform Huskisson that the wooden lock proposal was totally unacceptable in his view; and that he believed the large lock question merited further study in a broad context embracing military as well as trade and revenue considerations.\(^4^1\) In effect, the decision was thrust upon Huskisson, and perhaps rightly so as financial considerations were paramount in each case; and it was Huskisson, as Colonial Secretary, who would have to secure the required appropriations from Parliament once the decisions were made.

Following a serious study of the Bryce Committee Report, along with Lt. Col. By's reports and the Smyth Commission Report of 1825 on which the decision to proceed with the construction of the Rideau Canal had been based, Huskisson informed the Ordnance on 14 March 1828 of the course of action to be followed. The large lock question was to be decided by the committee of engineers to be sent to Canada in keeping with his expressed view as follows:

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It appears to me, that very considerable military and commercial advantages would accrue from enlarging the locks of the Rideau Navigation from twenty to fifty feet; and if the Committee shall concur in the opinion of Lieut.-Colonel By, that this important object can be effected at an additional expense of £50,000, with a further charge of £3,000 for widening the locks already begun, it will, I think, be advisable to leave to their discretion to authorize Lieut.-Colonel By to proceed with
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the construction of the locks, either to the increased dimension of fifty feet, or of any intermediate size between twenty and fifty, which may appear to them more expedient. 

This presented no difficulty; and the new Master General, Lord Beresford, immediately ordered two Officers of Engineers to proceed to Canada to serve on a committee under the presidency of Sir James Kempt to decide that question among others. The expenditure question was to be deferred until the Kempt Committee submitted its report to the government. In the meantime, Huskisson intended to request £41,000 from Parliament for 1828 in keeping with the appropriation of the previous year and the wishes of the Duke of Wellington who had become Prime Minister, January 1828, on the forming of a new government administration. But unbeknownst to Huskisson, developments on the Rideau had already deprived the government of any choice in the matter. Major expenditures could no longer be deferred or avoided.

Huskisson was informed by Lord Beresford that a progress report, dated 23 January 1828, had just been received from Lt. Col. By in which it was explained that contracts for the locks sites not yet contracted out would be let on 1 February 1828. These contracts would now be in effect; and the contractors no doubt were making preparations to commence work, if indeed, they had not started already. Consequently, any attempt to void the contracts would require "very onerous concessions" and entail a dead loss to government. In any case, whether it was decided to terminate the contracts or let them remain in force, the £41,000 proposed to cover expenditures in 1828 was insufficient. Lt. Col. By had paid out £28,614.7.2 between 1 November 1827 and 22 January 1828 on the several contracts already in force, and comparatively much more would be required for work performed under the new contracts during the busy summer work season. To Beresford, it was
clear that Lt. Col. By had not received the work restraint order in time, and was proceeding on the plan of completing the canal construction project in three years. To that end, he had apparently laid out work for completion in 1828 which would entail the expenditure of one-third of his total estimate. After deducting the amount expended to date from By's estimate of £474,844 and averaging the remaining sum over three years, the Master General concluded that Lt. Col. By would require about £140,000 for disbursements in 1828. But Huskisson had come to terms with the revised Rideau Canal estimates, and was able to take this new development in stride.

The Bryce Committee Report had proved to Huskisson's satisfaction that a much greater outlay would be required to construct the Rideau Canal than previously estimated; and now he saw clearly that a large expenditure was required in the present year no matter what course of action the government might determine to follow. To his mind, the blame for this situation rested directly on the inadequate, if not intentionally misleading, estimates of Clowes' survey report.

Although [he could not] but regret that Lieut.-Colonel By should have felt himself at liberty, before his increased Estimates had been considered and approved by the Board of Ordnance, to conclude contracts for carrying on the work on the present very extensive scale, and have entered into engagements involving so large an expenditure of public money, without waiting for specific authority from the department at home. Nonetheless, the Colonial Secretary had consulted with a number of individuals who were competent to weigh the arguments Lt. Col. By had advanced in favour of constructing larger locks capable of accommodating steamboats, and the opinions expressed were so strongly in their favour that the
government was prepared to prosecute the work on the large scale recommended by Lt. Col. By if need be, and to meet the immense costs involved. In Huskisson's view, expressed to Lord Beresford on 26 March 1828, the military and commercial advantages to be derived from the facility of transport afforded by steamboats, on a waterway where towpaths were impracticable for a good part of its course, more than compensated for the additional expenditure required to construct larger locks. The Kempt Committee, of course, would decide the lock size in keeping with Huskisson's previous guidelines; and Huskisson was anxious that the Kempt Committee be made aware that the future security and prosperity of Canada rested on their decision. To that end, he directed that they should be instructed to take into account local circumstances and the interests of the Canadian provinces, as well as exercise a due regard for economy in expenditure in deciding the matter. Where expenditures were concerned, Huskisson proposed to seek £120,000 from Parliament for the present year. This would slightly more than cover the £100,000 which Lt. Col. By had estimated would be required to meet his contract obligations in 1828, as well as the £15,000 deficit between the amount expended on the Rideau to that date, some £61,000, and the total amount voted by Parliament: viz. £5,000 in 1826 and £41,000 in 1827. In succeeding years, an even larger sum would no doubt be required in keeping with Lt. Col. By's estimate that a large lock navigation would cost about £527,844 in total; but the amount of subsequent annual appropriations could be decided at a later date.49 Detailed instructions were drawn up for the Kempt Committee in keeping with Huskisson's views,50 and the two Officers selected to serve on that Committee left for Canada to rendezvous with Sir James Kempt in Montreal. The strength of Lt. Col. By's arguments in favour of a large lock steamboat navigation is attested to by the fact that with Huskisson's acceptance of the revised estimate,
the Rideau Canal came to represent by far the largest single expenditure by the British government in North America, outstripping such projected works as the Quebec Citadel (estimated cost £220,000), the Kingston fortifications (estimated cost £214,649), and the Halifax citadel and outworks (estimated cost £266,000). Following the submission of the Smyth Report on the defences of British North America in 1825, the Ordnance had decided to seek approval for undertaking an extensive programme of building fortifications and canals in North America; and as of March 1828, it was estimated that the fortifications under construction, or proposed to be constructed, at Quebec, Kingston, St. Jean, St. Helen's, Montreal, Chateauguay, and Halifax would cost about £798,215 when completed in 1834 at a planned outlay by the Ordnance of at least £133,000 per year. The Canadian canals then under construction, either by the Ordnance or to which a contribution was being made in return for free passage for vessels on government business, were expected to cost the Colonial Department a total of £1,771,145 with the Rideau Canal at a now estimated £527,844 and the Ottawa canals at £110,000 comprising the bulk of the expenditure. The importance of the Rideau Canal in the British government's plans for the defence of British North America is evident in its willingness to accept the large increase in the Rideau Canal estimate from £169,000 to potentially £527,844. By's arguments had all but carried the day in London; but on the Rideau he was struggling to comply as best he could with the work restraint order transmitted at an earlier date.

**Developments on the Rideau in the spring of 1828**

The spring of 1828 was an especially trying time for Lt. Col. By as he awaited word from the Ordnance. If the large lock steamboat navigation were to be constructed with a minimum loss of work and materials, a decision had to be forthcoming before the commencement of the 1828 work season,
time was rapidly running out. He had expected to have been informed long since of the Ordnance's response to his plans and estimates, including the key decisions as to the monies to be allotted to the Rideau project for 1828 (By had recommended a minimum of £100,000) and the size of the locks to be constructed; but no word had been received. The large increase in the estimate, of course, had occasioned a delay which was further prolonged by the time lag, some eight to nine weeks or more, in communications between London and the Rideau. Consequently, Lt. Col. By was unaware of the decisions that had been made or those left open pending the report of the Kempt Committee. Indeed, in the spring of 1828, he was just receiving the correspondence containing the initial, somewhat shocked, reaction of the Ordnance to his estimates. On 10 March, the work restraint order arrived informing him that £41,000 would probably be appropriated for the Rideau project in 1828; and that he was to limit his expenditures and further contract engagements to that end.53 Lt. Col. By was placed in the embarrassing position of trying his utmost to comply with these instructions while at the same time being fully aware, as he explained to his superiors, of the impossibility of doing so.54 The Ordnance, of course, had already realized that fact from By's progress report of 23 January, and had secured the government's acquiescence in a much larger appropriation. However, this information, which was being conveyed to Lt. Col. By by the Officers appointed to serve on the Kempt Committee, was further delayed by transport problems occasioned by the vagaries of the weather.

While the Board of Ordnance had been investigating the plans and estimates forwarded to London, Lt. Col. By had not been idle. Acting on his original instructions to push on the construction of the canal as rapidly as possible, contracts were let on 2 February 1828 for all of the contract work remaining to be undertaken on the project, including 36 locks and the rest of the clearing, grubbing,
excavation and dam building required. 55 Indeed the only works excluded were the lock gates, bridges and sluice gates which By proposed to have constructed by the two companies of Royal Sappers and Miners employed on the Rideau. 56 When the work restraint order arrived on 10 March, By immediately discharged the sawyers, smiths, carpenters, labourers and squad masters employed directly by the Engineer Department, and made every exertion he could to drastically reduce expenditures in keeping with his new instructions. 57 However, he was defeated in this endeavour by the very success of his earlier efforts.

When the tenders were opened on 2 February 1828, Lt. Col. By had not expected that sufficient contractors would appear to enable all of the remaining work to be contracted at that date. But to his surprise, moderate bids were submitted for each and every contract. 58 In this manner, work worth an estimated £203,413.0.1 3/4 was contracted out to be completed in two years with payment to be made as the work progressed. 59 This, of course, was exclusive of the work previously contracted for, and represented a far greater outlay than By had expected would be required when he submitted his estimate that £100,000 would cover his projected disbursements in 1828. In these circumstances, By believed that the only recourse consistent with honour was to request the contractors to accept an extension of their contracts for at least a year, bringing the completion date to 1831, and to discourage them from vigourously pressing the work in the present year. 60 To that end, he let it be known that the government wished to proceed more slowly with the construction of the canal; and that this was all the more necessary as the size of lock to be built had not yet been determined. 61 But the contractors refused to comply with his request. The American contractors, in particular, were convinced that the faster a job was completed, the greater the profits to the contractor; and they not only threatened legal action if
their work was impeded in any way, but boasted that they would complete the contract work in one year.\textsuperscript{62} Lt. Col. By, as he informed the Ordnance, was placed in "a very unpleasant and distressing situation", made all the more so as he had assured the contractors on awarding the contracts that the government wished the work to be pushed with the utmost vigour and encouraged them to lay in all of the provisions, forage and tools required for the coming work season.\textsuperscript{63} This had been done; and a recent tour of inspection, conducted by Lt. Col. By in company with Col. Durnford the commanding Royal Engineer in Canada between 28 February and 10 March, had confirmed that all of the contractors were on their respective sites and actively engaged in collecting men and materials for the coming work season.\textsuperscript{64} Nonetheless, despite the intransigence and boasts of the contractors, By was convinced that the situation could be redeemed in large part.

The approach which By determined to take was relatively straightforward. On the one hand he was convinced, rightly as it turned out, that the contractors would be hard pressed to complete their contractual obligations in the two years allotted no matter how determined and confident they might be of doing so;\textsuperscript{65} and he consequently continued to offer them a time extension in the hope that they would realize that fact.\textsuperscript{66} But otherwise, he was determined to avoid placing any impediments in their way which would furnish a pretense for claiming damages from the government. At the same time, By proposed to limit his expenditures insofar as possible by keeping his disbursements of cash strictly to the terms of the contracts. In this manner, a major saving could be made in the projected short term outlay; but in view of the number of contracts so successfully concluded, By was forced to express his fear that even with the best of effort expenditures for 1828 could not be reduced or held to £41,000 as instructed.\textsuperscript{67} Although caught in a difficult situation as a result of the Ordnance's initial response to
his plans and estimates, Lt.Col. By strove to comply with his orders and to his credit refrained from any attempt to assess blame for the unexpectedly large increase in his estimate over the preliminary estimate furnished by Major General Sir James Carmichael Smyth. Nonetheless, he must have experienced some relief and comfort in Lord Dalhousie's assessment which accorded with views that By was to express at a later date.

When Lord Dalhousie, the Governor General and Commander-in-Chief of the Forces in British North America, received Huskisson's letter of 2 January advising him of the government's determination to investigate By's plans and estimates, he wrote, on 26 March 1828, to Lt. Col. By. Dalhousie explained that he had expected the Board of Ordnance would be shaken by the Rideau Canal estimates, as they would be in due course by the cost of all of the construction projects undertaken on the strength of the estimates provided by Major General Smyth's report of 1825. The better part of these estimates, in Lord Dalhousie's opinion, were excessively low; and the blame rested solely on the Smyth report which was prepared after a cursory examination of the various sites. In the case of the Rideau Canal in particular, Smyth had taken a great risk in basing his estimate on the "loose estimate of a Canadian wood surveyor"; and furthermore, it was Smyth who was in large part responsible for the present situation in having continually goaded and spurred Lt. Col. By to make every exertion to push on the canal work. Dalhousie assured By that "all justice will be done to your conduct, and wonderful exertions"; and that he would write to Huskisson, the Secretary of State, to inform him of By's current efforts to comply with the restraint order. But most importantly, Lord Dalhousie was fully in accord with By's determination to honour the contracts that he had entered into:
I shall also tell him that all contracts signed and sealed, must be met, as matter of public faith, and public honour; and the money must be forthcoming to the extent agreed for, and I am quite sure that all will be well, although you may ride slower in future years.\textsuperscript{68}

Unbeknownst to Dalhousie and By, of course, Huskisson had already determined on the above course and agreed to provide additional funds to cover the cost of the contracts; and the Bryce Committee had exonerated By's conduct and actions. The Bryce Committee, however, had refrained from assessing any blame for the large discrepancy in the estimates and Lt. Col. By did likewise. But in retrospect, it is clear that By must have agreed with Dalhousie's assessment. Over a year later in discussing the estimates with Col. Durnford, the Commanding Royal Engineer in Canada, By had occasion to mention that when he had first been informed at the Royal Engineers' Office at Pall Mall of his being chosen to construct the Rideau Canal with 20 foot wide locks at a projected cost of £169,000, he had remonstrated with Sir James Carmichael Smyth. By had maintained that the Lachine Canal, which was only 7 miles long and required only seven locks of moderate lifts and no deep cuts in an area where men, materials and provisions were easily procurable, had cost upwards of £137,000 (more correctly, £109,601); and that in view of this fact, he could not imagine how the Rideau Canal, some 135 miles long [sic] running through a virtual wilderness with 20 miles or more of excavation and several deep cuttings and 47 or more locks required to overcome a difference of elevation of 455 feet with attendant dams and embankments to control the spring floods, could be built for as little as £169,000.\textsuperscript{69} It is clear then that By believed he was in no way responsible for the imbroglio; and that if any blame were to be assessed, it had to rest on Major General Smyth who had framed the original estimate and had apparently not informed the Ordnance of the
doubts expressed by Lt. Col. By at that early date. But from By's point of view there were more immediate concerns requiring his attention.

As the weeks passed into months and still no word was received from the Ordnance as to the size of lock to be constructed or the possibility of extra funds being appropriated, the situation on the Rideau became increasingly difficult. Despite his best efforts, Lt. Col. By found that he could not exercise any real control over expenditures which were rapidly depleting the allotted funds. Although he achieved a measure of success in finally convincing the contractors to agree to a one year extension of the duration of their contracts, they steadfastly refused to bind themselves to any limitations on their rate of progress. Work therefore proceeded at a good pace; and once it became known that By's expenditures were limited to £41,000 in the current year, the contractors redoubled their efforts with each seeking to obtain as much as possible of the appropriation for himself. Elsewhere, all of By's efforts to reduce expenditures in the few areas amenable to his control had resulted in but trifling savings. Moreover, he was soon forced to confess to Col. Durnford that he had acted too hastily in dismissing his day workers. These men provided the moulds and profiles required before the contractors could proceed with their work; and he feared that if they were not re-employed, the contractors might well launch lawsuits seeking damages for any resultant delays. Compared to the damages that might be awarded, the wages of the men were insignificant; and By, therefore, requested Durnford's support for his decision to take them back on the payroll. As of mid-April, it was clear to By that it would be difficult to keep his 1828 expenditures below £100,000, let alone £41,000, given the rate at which the work was progressing; and that consequently more money had to be forthcoming. In a progress report forwarded to
the Ordnance on 5 May 1828, By explained his predicament and expounded in detail on the financial situation. Parliament had voted £5,000 in 1826 for the Rideau project, £41,000 in 1827, and apparently intended to vote £41,000 again in 1828, for a total appropriation to date of £87,000; but between the commencement of the construction work on 21 September 1826 through to 1 May 1828, By calculated that he had paid out £72,838.18.5 to the contractors who had yet to be paid for the full measure of work performed. Once this were done, it was more than probable that nothing would remain to carry on for the rest of the year. In consequence, By informed the Ordnance that he required a minimum of £100,000 inclusive of the £41,000 projected grant to cover his commitments for the current year. At the same time, he reaffirmed his belief that the canal could be constructed, at a 5 foot depth, for the estimated sum of £474,844 with 20 foot wide locks, and £50,000 more for a total of £524,844, to construct the 50 foot wide locks.75 This, of course, was exclusive of the £3,000 that would be lost through abandoning what little masonry work had been completed on the several locks in the Entrance Valley in keeping with the smaller scale of canal.

Despite the financial constraints under which he laboured, Lt. Col. By was apparently quite confident that additional monies would be forthcoming from the Ordnance, and was looking forward to pushing on once more with the work.76 To date, he had experienced serious setbacks at only two sites: at the Hog's Back, where sudden floods in February 1828 and again on 1 April 1828 caused extensive damage to the dam under construction,77 and at the Chaudière Bridge crossing where the last and largest of the six spans under construction, a wooden arched truss bridge over the Great Kettle rapids, collapsed totally on 11 April 1828.78 The projected expense of repairing the Hog's Back dam did not concern By overly much as such setbacks were to be expected from time to time in dam construction.
work, and had been allowed for in the 10 per cent added to the estimate for contingencies. The re-building of the Great Kettle span entailed an additional expense; but this was rather limited as the materials had been salvaged for re-use. Once he completed his now customary spring tour of inspection through the Rideau system and return, as planned from the 7th through 19th May, By intended to re-commence the building of the Great Kettle span with work to follow on the Hog's Back dam once the spring floods receded. Indeed, whatever vexation By experienced was caused not by construction problems or financial constraints, but by the contractors who complained incessantly of being held up by the lack of a decision on the size of lock to be built. 79

As early as mid-April 1828, Lt. Col. By began to think it strange that no comment or instructions had arrived from the Ordnance regarding his large lock proposal. In consequence, he refused to approve the commencement of any lock masonry work in the new work season much to the annoyance of the contractors. To avoid further delay and aggravation, By had approached Col. Durnford on 21 April for advice as to whether he should proceed with constructing the small 20 foot wide lock, or "whether it would not be most advisable" to take the initiative and commence building the large 50 foot wide lock at such places as Jones's Falls where the contractors were ready to commence the lock masonry. 80 In view of the constraints newly placed on the Rideau project by the Ordnance, and the general expectation that the Board's comments on By's plans and estimate would arrive shortly, Col. Durnford reluctantly concluded that the contractors must continue to be confined to preparing stone for the locks. 81 But there was only so much preliminary work to be done, and with the lock masonry work in abeyance pending further instructions from the Ordnance and the allotted funds approaching exhaustion, work on the Rideau Canal ground almost to a halt during the
month of May and continued in an all but suspended state into the early weeks of June 1828 when a letter arrived at the Rideau Canal Office from the Ordnance.

The communication from the Ordnance did little to relieve By's anxieties as it relayed nothing with respect to either the large lock question or developments over the 1828 appropriation for the Rideau Canal project. It was merely an enquiry, contained in two minutes dated 8 and 11 March, requesting information as to what sum would have to be added to the estimate for the support of the Rideau Canal establishment. In studying the estimates conveyed to London by Lt. Pooley, General Mann had noted that the £474,844.1.2 1/2 total estimate for the Rideau project did not include the cost of maintaining the military and civilian staff employed to superintend its construction. He realized that it would probably entail a considerable outlay; but one which was difficult to estimate as the date of completion for the project was uncertain. This information was passed on to the Master General, Lord Anglesey, who in turn informed Huskisson when forwarding the Bryce Report to the latter on 26 January 1828. Now, the question could no longer be left in abeyance. As the Ordnance continued its investigation of the Rideau Canal estimates, information was required on the estimated cost of supporting By's establishment, including the two companies of Royal Sappers and Miners assigned to the project, and the two additional Companies of Royal Sappers and Miners that he had requested be sent out. It was also apparently suggested that By might well be able to use part of his 10 per cent contingency allowance to cover the cost of maintaining his establishment.

Lt. Col. By explained, in a letter to the Ordnance 10 June 1828, that he had been assured by Lord Dalhousie that the expense of the Rideau Canal establishment would be carried on the Extraordinaries of the Army, and in consequence, had confined his estimate to what would be
required to construct the canal. If this were not to be the case, then the estimate would have to be increased as the allowance for contingencies was no more than sufficient to cover any additional work that might be found necessary as construction progressed. Already, it was evident that the bedrock uncovered in several of the lock excavations was not sufficiently sound to serve as a lock floor, and would require the building of more inverted arch masonry floors than planned. Moreover, an outbreak of fever at several of the locksites had necessitated extra clearing work to ensure a better circulation of air; and more generally, the heavy dam construction work was of such a nature as to be subject to flood damages which the ten per cent allowance would scarcely cover. In effect, the estimate would have to be increased from £474,844.2.3 1/4 to £535,414.0.3 1/2 to meet the cost of the establishment; and this did not include the two additional Companies of Royal Sappers and Miners. Although they would have been exceedingly useful on the Rideau project, under the new scheme of things By adjudged them too expensive to maintain and so withdrew his request for their services. At the same time, he declared that if the canal were to be completed in four years, £147,103.10.0 would be required for disbursement in each subsequent year, 1829 through 1831 inclusive, in keeping with the augmented estimate; and of course, £53,000 more in total if it were decided to construct the large lock. To that end, a new lock design had just been completed for the 50 by 150 foot lock with a five foot depth; and By was hopeful that the Kempt Committee, whom he was expecting daily, would authorize him to build the large lock in keeping with the new design.87

The Kempt Committee investigation and report, June 1828
Sir James Kempt had received orders from the Ordnance early in May 1828 to proceed as soon as possible to Canada and rendezvous at Kingston with Lt. Colonels Fanshawe and Lewis
who had been appointed to serve under him in investigating the Rideau Canal estimates on the spot. Lt. General Kempt immediately arranged for the command of the troops in Halifax and his government functions to devolve on others, and made plans to sail from Pictou as soon as the ice fields of the Gulf of St. Lawrence were passable, on or about the 20th of May, so as to arrive in Quebec by the end of the month. But persistent fogs, a late spring breakup and contrary winds delayed his arrival at Quebec until 12 June. The next day at Montreal he encountered Fanshawe and Lewis, who had preceded him there via New York; and the party pushed on to Kingston where they were met by Lt. Col. By on the evening of 15 June 1828. Although By had had to come down the Rideau system at an exceptionally hot time of year with the black flies in season, he must nevertheless have derived a great deal of satisfaction at their arrival as the Committee's instructions, conveyed by Lt. Col. Fanshawe, were all that he could have hoped them to be.

The instructions made it clear that the primary interest of the Ordnance Board was to economize as much as possible on the expenditure of public money, while at the same time securing the construction of a durable and viable canal system. In keeping with this intention, the committee was ordered to examine By's work on the spot and compare his plans and estimate with those of Samuel Clowes' to determine the most practicable, secure and economical mode of completing the canal. In addition, the masonry contracts were to be examined to ascertain whether the extra works, the bridges and roads, constructed by Lt. Col. By, had resulted in lower tenders than would otherwise have been the case. But most importantly, the committee was informed that in view of the "very considerable military and commercial advantages" to be realized by the construction of a steamboat navigation, they were at liberty to authorize the construction of the requisite large 50 by 150 foot lock
providing it could be done for an additional £53,000; and in all of their deliberations, they were to keep in mind that the large locks might well be deepened to 7 or 8 feet at some future date. But regardless of the size of lock to be built, the Rideau Canal expenditures for 1828 were to be limited to £105,000 inclusive of whatever monies Lt. Col. By had expended between January 1828 and the present. Thus, not only was more money forthcoming, and in an amount sufficient to meet pressing demands in the current year; but By now realized that his arguments in favour of the large lock steamboat navigation had won acceptance from the government as well as the Ordnance Department even to the extent of their being willing to contemplate deepening the large lock canal in future to accommodate the large Great Lakes steamboats. Indeed, Lt. Pooley had already prepared at the behest of the Ordnance an estimate of the costs involved in raising the water level in the projected Rideau Canal two feet for that purpose.

Lt. General Kempt lost no time in getting the inquiry underway. Guidelines were prepared which made it clear that no digressions were to be tolerated in what he intended to be a precise and methodical investigation of all aspects of the Rideau Canal project under question. To that end, the inquiry was broken down into a number of pertinent questions which were to be examined one by one: viz. the details of how the estimate was arrived at; the practicability and durability of By's canal configuration; the contract prices tendered for the masonry before and after the bridges and roads were constructed; the system of superintendence and keeping of accounts; the details of By's scheme to increase the length and breadth of the locks and the cost of the same; and the practicability and expense of increasing the depth of the canal to 7, 8 or 9 feet. Two additional points of inquiry were added by Lt. General Kempt concerning the defence of the canal works: viz. how best, and most economically, to protect the canal works from sudden attack.
by an enemy; and whether or not, and at what cost, all of
the locks might be placed on the far, or rear, side of the
river to render them less accessible to an incursion from
the frontier. The committee was to be in session each day
from 4:00 A.M. until 6:00 P.M. conducting their
investigation; and members of By's staff were to be present
at all times to answer directly any questions raised.96
This procedure was followed at each lock site in turn as the
Kempt Committee during a period of roughly two weeks
examined all of the works in progress.97

The Kempt Committee was somewhat surprised by the
magnitude of the Rideau Canal project; and yet highly
pleased at the quantity of work that had been accomplished
and the way in which the project had been organized.98
But they must have been taken aback when, during the course
of the inquiry, Lt. Col. By submitted a substantially
revised Rideau Canal estimate together with a statement of
his expenditures to date. The submission consisted of a
copy of By's 10 June 1828 letter to the Ordnance in which he
had explained why £60,614.18.0 l/4 would have to be added to
the Rideau Canal estimate to cover the cost of the military
and civilian establishment, together with a letter stating
that additional monies would be required to meet unforseen
expenditures. It had proved impossible to route the canal
as planned so as to avoid destroying several of the saw and
grist mills on the Rideau system, and a change in the canal
layout above Kingston Mills, where the locks projected at
Jack's Rifts and Billadore's Rifts were to be eliminated in
favour of adding locks at Kingston Mills and raising the
water level there, had resulted in the drowning of 1,324½
acres of private property. In consequence of these
developments a further £8,500 was required to buy out the
mill owners and £662.2.6 to compensate the proprietors of
the drowned lands.99 These sums when added to the
original estimate together with the £53,000 extra required
to construct the large locks, would bring the Rideau
estimate to a total of £597,676.2.9 1/2. As of 20 June 1828, a total of £87,683.17.11 3/4 had been expended on the Rideau Canal project since its inception, which in keeping with the latest revised estimate left a balance of £509,992.4.9 1/4 to be expanded over the rest of 1828 through to 1831 inclusive. In effect, the extra monies required to build the large locks, support the Rideau Canal establishment, and pay damages for mills and land drowned by proposed changes in the canal layout, totalled £122,777.0.6 1/4, or about a quarter of By's original estimate. Indeed, after almost two years of work and the expenditure of £87,683.17.11 3/4, the sum remaining to be paid out if the large lock navigation were to be built, was still greater than the estimate Lt. Col. By had formed on 1 November 1827 for the total cost of the project if constructed with the 20 foot wide locks.

The Kempt Committee completed their report at Kingston on 28 June 1828, and the following day gave instructions to Lt. Col. By based on their conclusions. In the first place, By was authorized to proceed with the work in hand on the Rideau Canal, but was not to undertake any new work until he had paid up all of his accounts in full and prepared a statement for the Committee of his expenditures in the current year up to 30 June 1828. Thereafter, he was to carefully monitor the progress of the work to ensure that his total expenditure for 1828 would not exceed £105,000. Although admittedly aware of the difficulties involved in superintending a project of the nature of the Rideau Canal spread over a vast distance in a virtual wilderness, the Committee nonetheless insisted that a much more regular and vigilant supervision of the work was required by the professional staff than had hitherto been the case to ensure a proper economy of public money and the construction of durable structures. To that end, the Committee directed that the military officers and professional civilians on By's staff should be dispersed
along the line of the canal so that each work site would receive a daily inspection. The progress of the work so inspected was to be fully recorded in a diary, and an abstract forwarded weekly to Lt. Col. By, the commanding Royal Engineer. In the same manner, all checks of time and measurements of work accomplished were to be entered in an account book, and signed by the contractor or his foreman. An abstract of the account book was to be forwarded quarterly to By Town to enable payments to be made in keeping with the terms of the contract.

With respect to the canal proper, the Committee declared that the navigation should be constructed to a minimum depth of 5 feet with locks capable of containing a steamboat 30 feet wide across the paddle boxes and spars 108 feet long clear of the gates. Several novel features of By's large lock plan were rejected in favour of a more orthodox lock design; but they approved the design of Lt. Col. By's large dams as well as changes that he had made in the layout of the locks at the Hog's Back, including the inundation of Dow's Great Swamp, and at Kingston Mills, including the elimination of the locks proposed for Jack's Rifts and Billadore's Rifts. These changes in the lock layout were made on engineering grounds; but elsewhere military considerations came into play. However, the Committee found that the locks had been well positioned to take advantage of the natural configuration of the river banks; and consequently, they abandoned their original aim of having all locks located on the rear side of the river away from the distant frontier. Once these points were resolved, Lt. Col. By was instructed to prepare an estimate for the Committee based on the new scale of canal in keeping with their decisions.

Lastly, Lt. Col. By was given instructions as to several steps to be taken to provide for the future defense of the canal. Henceforth, the lockmasters' houses were to be constructed as defensible guard houses and so situated as
to provide protection for the locks and dams at their respective locksites; and Lt. Col. By was to determine where major military works might best be constructed at a later date for the defence of the canal and make arrangements for the purchase or reservation of the land required. In particular, he was instructed to make an accurate survey of the By Town area and reserve sufficient land for the eventual construction of a depot for 5,000 men.

On the same day as the above instructions were received, Lt. Col. By prepared and submitted a plan for the locks on the scale determined by the Committee together with a revised estimate, and assurances that he would do everything in his power to comply with his instructions as to the monies to be expended, the system of superintendence desired, and the steps to be taken to provide for the defence of the canal. The new estimate, which the Kempt Committee incorporated into their report, was £576,757.14.9 1/2 for the approved lock which Lt. Col. By had determined should be 33 feet wide by 134 feet long to comply with his instructions. As a means of comparison, By also submitted a final estimate for his proposed 5 foot deep large lock navigation of £597,676.2.9, and for the originally projected 20 by 108 foot lock canal of £544,676.2.9, with a supplementary itemized cost breakdown of each estimate. In effect, £20,918.8.0 was to be saved by reducing the size of the large lock. All three estimates, of course, included the cost of the Rideau Canal establishment as well as the allowance to cover damages to be paid to the mill and land owners whose properties would be inundated by the canal, but did not include the cost of constructing military works and bridges along the canal or the purchase of the land needed for military purposes as these needs had not yet been determined. Once the Kempt Committee had By's final estimate in hand, their report was forwarded directly to William Huskisson, the
Colonial Secretary, who unbeknownst to the Committee had resigned from the Duke of Wellington's administration on 29 May 1828. The report explained in detail the reasoning behind the decisions and instructions conveyed to Lt. Col. By.

The Kempt Committee reported that the Rideau navigation as planned by Lt. Col. By was practicable and would have sufficient water to operate effectively even in the driest of seasons. The contracts were carefully drafted; and Lt. Col. By was to be commended as it appeared his "personal and zealous exertions" had materially assisted in securing low tenders for the work. Moreover, there was every reason to believe that economy has not been heedlessly lost sight of by Lieut.-Colonel By, and that he has, in accordance with what he believed to be the spirit of his Instructions, pushed forward, and excited a degree of exertion throughout the Department, which few individuals would have accomplished.111

To ensure a similar economy of public money in future, the Committee insisted that henceforth a more strict supervision would be required at the worksites (as mentioned above). As to the roads and bridges constructed by Lt. Col. By, the former were found to have been absolutely necessary for carrying on the work, but this was not as clearly the case with the Chaudière bridges. However, there was no doubt, that the prospect of a bridge communication with the settlement of Hull had encouraged contractors to bid on the canal works, and the finished crossing would facilitate the settlement of the country round about. More generally, contracts had been entered into for about four-fifths of the work required; and the Committee felt they had no alternative but to authorize Lt. Col. By to proceed with constructing the canal, while limiting his expenditures in 1828 to £105,000 as they feared that to suspend operations would result in the government being sued for breach of
contract. In consequence, Lt. Col. By had been instructed to proceed in keeping with what the Committee believed was "the most practicable means" of completing the Rideau navigation to meet "all probable naval and military purposes and for the Commercial use of the Upper Country." The Kempt Committee, however, inserted a statement that by their calculations the Rideau Canal, with the approved 33 by 134 foot locks, could be constructed for £558,000 rather than the £576,757.14.9½ final estimate submitted by Lt. Col. By. 112

In deciding the size of lock to be built, the Committee made it clear that their primary consideration was to secure a dependable means of propulsion for military transport vessels. Towing was not feasible, as lengthy sections of the navigation were unsuited to the building of tow paths; and although sails and sweeps might well serve commercial vessels, they would not suffice in war operations. The construction of a navigation on a sufficient scale to handle steamboats, either for towing or transport, appeared the only alternative. To this end, the building of a 50 foot wide lock with seven feet of water on the sills had been considered by the Committee; but they informed that ongoing survey work had revealed that the river banks were of insufficient height to allow the water to be raised several feet and in consequence deepening the canal beyond five feet would be prohibitively expensive. 113 In the judgement of the Committee, the construction of the large lock, without a proportionally deep canal, was of no particular advantage; and this was particularly so without correspondingly large locks on the Ottawa River canals and at Montreal. Therefore, the Committee decided on a five foot deep navigation with locks sufficiently large to accommodate the steamboats then in service on the Ottawa River which were equal in size to the smallest of the steamboats plying the St. Lawrence River: viz. 30 feet wide over the paddle boxes and 108 feet long. Such a lock would
also handle spars intended for the Royal Navy up to that length as well as two Durham boats at a time. (The Durham boats, as mentioned, were 60 feet long and had a 9 to 13-1/2 foot beam, but the largest of the spars intended for the Royal Navy were 120 to 130 feet long.) In conclusion, it was stated that a small steamer, with a 32 horsepower engine, could easily tow two Durham boats at a speed of four to five miles per hour on the stretches of stillwater to be formed by the Rideau Canal dams; and that the Durham boats used extensively on the St. Lawrence River would be available in sufficient numbers to provide ample transport for military movements and/or naval stores.114

Lt. Col. By was highly pleased, and no doubt much relieved, to read the instructions drafted by the Kempt Committee. Not only was he authorized to proceed in constructing the canal with sufficient funds allocated (£105,000) to cover all of his commitments for the current year; but it was evident that, despite a more than three fold increase over the original Smyth estimate for the Rideau canal project, he would receive the sum required to complete the canal with locks of the newly approved size, including the cost of maintaining the civil and military establishment and compensating the mill and land owners whose properties would have to be expropriated.115 Moreover, the committee had not been able to improve on the proposed layout of the locks; and Sir James Kempt appeared to agree with By's assessment of the strategic importance of By Town in recommending that a military depot of 5,000 men be constructed there. But most importantly, the Kempt Committee had accepted By's argument that the Rideau Canal ought to be constructed with locks sufficiently large to pass steamboats and spars for the Royal Navy; and from that standpoint, By was convinced that the approved lock would "answer every purpose."116

On his way back through the Rideau waterway, Lt. Col. By laid out the locks of the approved dimensions at each of
the lock sites so that the contractors might resume their work; and on his arrival in By Town, immediately wrote to Sir Peregrine Maitland, the Lt. Governor of Upper Canada, to inquire what steps were required to gain possession of the mills and lands for which compensation had now been provided. His only regret was that unseasonably high water levels on the Rideau and Ottawa rivers prevented his commencing immediately the reconstruction of the Hog's Back dam and the great Kettle span of the Chaudière bridge crossing. However, by the first of August, work was again well underway at the Hog's Back dam, the bridge span, and all of the lock sites on the Rideau Canal; and at By Town, McKay and Redpath were beginning to lay the floor of the first lock to be constructed on the new scale. Although much time had been lost through the imposition of restrictions on By's expenditures in the spring of 1828, and sickness was to bring the work almost to a standstill at several of the lock sites during the late summer and early fall of 1828, Lt. Col. By was able to report in November that "an astonishing quantity of work [had been] performed" during the 1828 work season, and so much so that he was confident the whole canal would be completed as scheduled by 12 August 1831.

The debate over the size of lock to be built on the Rideau Canal and the delays occasioned in commencing the lock masonry work by the lack of a decision prior to 29 June 1828, apparently had no major ill effect on the progress of construction or at least none comparable to the lack of funds in the spring of 1828. Only three locks had been commenced on the scale of the Lachine locks, 108 feet by 20 feet with 5 feet of water on the sills, and the masonry work had been halted at a point where conversion to a larger lock would entail the loss of only £3,000 in labour and materials. From then on, the contractors had been under orders to confine their masonry work to the preparation of stone for the locks. Consequently, the decision to build
locks 134 feet by 33 feet with 5 feet of water on the sills, was not all that disruptive. However, had a decision not been reached at this time, it would have had a serious negative impact on the construction schedule now that funds were once again available to enable Lt. Col. By to push on with the work.

It had taken two years from the time that Lt. Col. By first advocated (13 July 1826) the construction of a large lock steamboat navigation for all of the repercussions to be worked out and a decision reached on the size of lock to be built on the Rideau Canal. Initially, he had hoped to be able to build the canal with locks 150 feet by 50 feet with 10 feet of water on the sills in conjunction with similarly large locks at Rivière des Prairies to by-pass the Lachine Canal, and on the Ottawa and the Welland canals so that the large lake steamboats could circulate from Quebec through to the upper lakes and vice versa; but the cost of such a construction project was judged prohibitive. Barring that, By would have preferred to build locks 150 feet by 50 feet with a 5 foot minimum depth on the Rideau Canal alone and to have made do with the smaller 108 foot by 20 foot locks of similar depth on the Lachine and Ottawa River canals. If the large locks of reduced depth had been authorized, the large lake steamboats could have circulated from Lake Ontario through the Rideau Canal to By Town and down the Ottawa River as far as Grenville at the head of the Ottawa River canals, but would have had to lighten their load at Kingston to reduce their draught. In time of war, the armed lake steamers, which were much faster and more heavily powered than the smaller river steamboats, would have been able to transport troops and war supplies through the Rideau Canal and beyond as far as the Niagara frontier; and frigates, constructed in the security of the remote interior at By Town, could have been towed through the Rideau system to Kingston to be fitted out for service on Lake Ontario. Moreover, Lt. Col. By hoped that the
Ottawa-Rideau navigation would become the major trade route linking the Great Lakes with the ocean; and that in time, the other canals would be enlarged to match the Rideau Canal locks, and all of them deepened to enable the large lake steamboats to pass directly from the ocean port of Quebec through to the head of the lakes. In the meantime, the large steamboats, either lightened at Kingston or not fully loaded at Grenville, would have been able to carry freight through the five foot depth of the Rideau Canal, as well as tow timber rafts through the system towards Montreal. On the way to Montreal, the freight would have had to be transhipped at Grenville into Durham boats for passage down the Ottawa and St. Lawrence rivers where steam tugs were stationed to tow the Durham boats and timber rafts on the river sections between the canals. The latter, which were under construction or about to be constructed, consisted of the three short Ottawa River canals (the Grenville, the Chute à Blondeau, and the Carillon), the single Vaudreuil lock at the junction of the Ottawa and St. Lawrence rivers, and the Lachine Canal. At each of these canals the Durham boats under the existing system of transport were towed through the locks by horses or oxen and the rafts shot through the rapids of the river. On the upstream trip, the Durham boats were handled in the same manner; but at Grenville the freight would have been transhipped into large lake steamboats to pass through the large locks of reduced depth had they been constructed on the Rideau Canal. But such was not to be the case.

The decision in favour of building locks 134 by 33 feet with 5 feet of water on the sills, did not affect the existing transport system on the Ottawa and St. Lawrence rivers which By had incorporated into his second scheme; but it did force a change in the mode of transporting freight that By had envisaged for the Rideau Canal. The large lake steamboats could not pass the 134 by 33 foot locks; and therefore, Durham boats would have to be used in conjunction
with the limited capacity small steamboats for transporting freight on the Rideau Canal. The freight would have to be transhipped from lake steamboats to these vessels at Kingston for passage through the Rideau Canal and beyond to Montreal; and the Durham boats carrying freight upriver from Montreal would have to be towed all the way up the Ottawa River to, and through, the Rideau Canal to Kingston where their cargoes would have to be transhipped into the lake steamers. However, on the Rideau Canal in contrast to the Ottawa River and Lachine canals, the smaller river steamboats used to tow the Durham boats, would be able to pass through the locks as would also the timber rafts and spars. In effect, the approved locks converted the Rideau waterway into an uninterrupted river steamboat navigation from Kingston to Grenville. Had the smaller 108 by 20 foot locks been authorized in keeping with the original plan to construct a gunboat canal, the navigation system would have been greatly impeded. The configuration of the Rideau Canal with its high dams was such that the timber rafts would have had to have been broken up at each locksite and the individual timbers dragged by oxen around the dam; and the spars also would have had to be dragged in the same manner. Moreover, there were 22 lock sites on the Rideau Canal and placing a steamboat on each of the river stretches in between the locks was out of the question. If the 108 by 20 foot locks had been built, the Durham boats, and in war time the gunboats, would have had to be poled, rowed or sailed on a large number of the river sections with all of the consequent delays. As it was, Lt. Col. By had good reason to be pleased with the adoption of the 134 by 33 foot locks, and all the more so when the Rideau, with the approved locks, was compared to the upper St. Lawrence route which By hoped the Rideau-Ottawa route would supersede as the main artery of commerce. The Rideau Canal would be a through steamboat navigation and as such far superior to the upper St. Lawrence River transport system where Durham boats
still had to be lightened and at times unloaded to be towed by horse, ox or men, through the several rapids.

From a military point of view, the decision to build locks 134 feet by 33 feet was in large part compatible with By's proposed strategy for the defence of Upper Canada. It would, however, negate By's proposal that the major naval dockyard for constructing warships for service on the lakes be built at By Town as frigates could not pass through locks of that size. In any future conflict, warships would have to continue to be constructed at the Kingston dockyard which By considered to be extremely vulnerable to attack.

Likewise, the large lake steamboats, which By suggested be armed in war time to serve as gunboats, could not be used to transport troops and supplies along the Rideau system. Nonetheless, the key components of By's military strategy were preserved. The Rideau Canal would be an uninterrupted steamboat navigation plied by the smaller river steamboats, which although considered unseaworthy on the lakes, could be armed to serve as gunboats on the Rideau Canal as well as used to tow Durham boats loaded with heavy ordnance, troops and supplies. The smaller steamboats provided a relatively fast and dependable mode of propulsion for transporting an army as opposed to Durham boats and gunboats propelled by poles, oars and sails as was envisaged in the defence plan of the Duke of Wellington and Major General Carmichael Symth. In moving troops and supplies from Quebec or Montreal to Upper Canada, transhipment would be required only at Kingston from the Durham boats into the armed lake steamboats to continue the voyage. The mobility and speed of transit that By counted on to concentrate troops rapidly in the field at any threatened point was assured by means of the river steamboats plying a secure interior communications route and the armed lake steamboats which were capable of transporting troops and supplies as far as the Niagara frontier and to any point in between on either side of Lake Ontario as desired. Moreover, with the speed, and
cheapness, of transportation provided by steamboats, whether by large lake transport vessels on the lakes or smaller vessels towing Durham boats on the Rideau Canal, it was also practicable, as By suggested, to construct the principal depot for military and naval store intended for the defence of Upper Canada at By Town in relative security rather than at Kingston on the frontier. Indeed, Sir James Kempt's recommendation that a depot of 5,000 men be constructed at By Town was a measure aimed in that direction.

As Lt. Col. By no doubt realized the essence of his proposed military strategy for the defence of Upper Canada was not negated by the decision to build the 134 by 33 foot lock, quite the contrary. Although the locks were not to be as large as he would have liked, they were sufficiently large to pass steamboats; and By continued, in constructing the Rideau Canal, to hope that the commercial-military role he envisaged for the canal might some day be realized.

Completing the Canal and the Recall of Lt. Col. By
The Board of Ordnance accepted the Kempt Committee Report, including the estimate and recommendation that the Rideau Canal should be constructed with locks 33 feet by 134 feet with a minimum of five feet of water on the sills, as did the Colonial Department and the Lords Commissioners of the Treasury in turn. However, it was the Kempt Committee estimate of £558,000, rather than Lt. Col. By's estimate of £576,757.14.9½, that was reported to the Treasury in November 1828 as the final cost estimate for the Rideau Canal project. At the same time, the Treasury was informed that to complete the Ottawa River canals with the 134 by 33 foot locks would cost a total of £176,640. Both estimates were accepted without demur, and the Lords Commissioners agreed to request £130,000 of Parliament for the Rideau Canal in 1829 (roughly one-third of the money required to complete the canal by 1831 in keeping with the £558,000 estimate, less the monies expended to that date)
and £32,233 for the works on the Ottawa for 1829. No provision appears to have been made for financing the proposed Rivière des Prairies navigation, although the Board of Ordnance was in receipt of a report from Lt. Col. Fanshawe advocating that locks be constructed to the north of Montreal to by-pass the smaller locks of the Lachine Canal; and Lt. Col. By continued to act on the assumption that the Rivière des Prairies locks would be constructed to provide an uninterrupted steamboat navigation from Quebec to Kingston. Indeed Lt. Col. By had every reason to expect that monies would be forthcoming for the construction of the proposed Rivière des Prairies navigation if he could but keep his Rideau Canal expenditures in line with the estimate accepted by the Treasury; but that proved to be impossible. No matter how carefully Lt. Col. By managed to pare down his expenditures, he ultimately found himself in a desperate situation because the Kempt Committee in its report, and more importantly the Ordnance in accepting the Committee's June 1828 estimate and conveying it to the Treasury, neglected to address two crucial points of which they were well aware: viz. the impossibility of limiting expenditures under the contract system entered into for building the Rideau Canal; and the virtual impossibility of determining an absolute, and final, cost figure for a project of the magnitude of the Rideau Canal undertaking subject as it was to innumerable contingency expenses. (Moreover, regardless of whether Lt. Col. By managed to construct the canal within the estimate, either the Kempt Committee's estimate of £558,000 or his own of £576,757, further expenditures would be required. These estimates covered the costs expected to be incurred in constructing the canal, including the cost of the Rideau establishment and an allowance to cover damages inflicted on private property by the raising of the canal waters, but did not include any estimate for the purchase of military lands or
the erection of the structures which were recommended for the defence of the canal.)

On previous canal construction efforts, such as in building the Ottawa canals, the Ordnance had followed a system whereby annual appropriations were requested from Parliament to fund the project as it progressed, and day workers were employed under the direction of an establishment of Royal Engineers or Officers of the Royal Staff Corps to do the work. When the monies appropriated for the year were exhausted, the men were dismissed and the project suspended until the following year. While this system enabled the Ordnance to keep a close check on annual expenditures, it also resulted in projects dragging on interminably. However, the State of New York and the City of Montreal in building the Erie Canal (1817-1825) and the Lachine Canal (1821-1825), respectively, had contracted out the work; and Major General Carmichael Smyth, on the basis of their respective experiences, had concluded that the Rideau Canal should be constructed by contract. There were sufficient contractors to undertake the work, and if careful specifications were prepared by the engineering staff, Smyth was convinced the canal could be constructed much more quickly, with a fixed termination date, and economically by contract than by day work. In addition, he speculated that a much smaller establishment of Royal Engineers and Clerks of Works, possibly three or four of each, would be required to superintend the project than would be the case under the day work system. Both Smyth, and the Board of Ordnance, however, had been aware that the full benefits of the contract system could not be realized if the progress of construction were strictly tied to the annual parliamentary grants as under the old system.

Upon his appointment to superintend the construction of the Rideau Canal in March 1826, Lt. Col. By had been informed by Major General Smyth that he was to proceed by letting contracts through the Commissariat Department to
individuals competent to construct the various sections of the canal. The contracts were to cover the duration of the project, and in consequence Major General Smyth explained that:

the whole of the Cost must be asked for from Parliament at once, as the Contractors must be at liberty to commence as early in the season as circumstances will permit without waiting for the passing of an annual grant. He must be enabled to arrange for the feeding and lodging of his work people for one or two years beforehand, which he cannot do if a fresh contract is to be entered into each season.

But Lt. Col. By had objected that the £169,000 preliminary estimate was unrealistically low when compared to the costs incurred in constructing the Lachine Canal; and when he repeated this assertion to General Mann, the Inspector General of Fortifications who was to be By's liaison with the Board of Ordnance, he had been told that:

it is impossible to decide what the sum required will amount to; you will have to use your own judgement, as the work is intrusted [sic] to you; it is to be carried on as an Ordnance service, but when completed the accounts are to be handed over to the Treasury.

Clearly from the inception of the project, there was a serious difference of view among the three men most responsible for getting the Rideau Canal work underway as to whether the probable cost of construction would approximate the preliminary estimate of £169,000, would greatly exceed it, or was really impossible to calculate in any meaningful way at that juncture. Not only was this difference not resolved, but steps were taken to speed the construction of the canal which deprived Parliament of its control over expenditures.
In the spring of 1826, the government had been informed by the Ordnance that £169,000 would be needed to construct the Rideau Canal, and £5,000 was thereafter voted by Parliament to get work underway in that year with additional sums to be voted in subsequent years. (The Ordnance had decided to request between £10,000 and £18,000 for the first year, but the government reduced the request to £5,000 and did not inform Parliament of the amount of preliminary estimate.) This procedure reflected the practice formerly followed in financing canal construction projects and was totally out keeping with the contract system that Major General Smyth intended to inaugurate. Nonetheless, the Board was determined to realize the full benefits of the new contract system and, as the annual votes were to be included in the Colonial Estimates, requested whether the Colonial Department would agree "that as the measure has to a certain extent been agreed to by Parliament", there should be no objection to the contractors proceeding each year with the work without waiting to be notified of the amount of the parliamentary grant.131 Lord Bathurst, the Secretary of State for War and Colonies, concurred that the work should be pushed on with all possible despatch, and His Lordship is of the opinion that it will be proper to authorize the contractor to commence as early in the Season as circumstances will permit without waiting for the passing of the Annual Grant.132

To implement this system, the Ordnance forwarded instructions to the Commissariat Department that in order to avoid having to suspend operations in the spring while awaiting the arrival of the authorized expenditure for each successive year, payments were to be made upon Lt. Col. By presenting the proper documents, and that whatever may be the sum disbursed, whether more or less than the estimated annual grant each
year, the same will be drawn from the Military Chest of the Commissariat Department.133 Expenditures in any given year therefore, were not to be limited to the annual appropriations voted by Parliament as had hitherto been the case; and what is more, as the Master General, the Duke of Wellington, was well aware, the Rideau Canal project since it was being carried on the estimates of the Colonial Department was being undertaken on the authority of the Secretary of State "without previous reference to Parliament" as opposed to the fortifications to be built by the Ordnance which were not to be undertaken until the detailed plans and estimates had been prepared and laid before Parliament.134 Herein lay the seeds of all of Lt. Col. By's later difficulties over his estimates. To speed construction and take full advantage of the possibilities of the new contract system, no limits were put on the annual Rideau Canal expenditures or written into the terms of the contracts; and the project was commenced on the basis of a highly questionable preliminary estimate before the customary detailed plans and estimate could be prepared and submitted to Parliament for approval.

The Master General of the Ordnance, the Duke of Wellington, had seen clearly that the Rideau project was being undertaken in a rather unconventional way. As indicated by his remarks, the proper course of initiating a large scale construction project would have been to have submitted the rough preliminary estimate to Parliament, and on the basis of that, to have requested a limited sum to undertake the survey work and planning required to prepare a detailed, reasonably accurate, estimate for the cost of the project. This working estimate would then have been submitted to Parliament to obtain approval for undertaking the actual construction work. Under this system Parliament retained the power to veto the project if the costs to be incurred proved to be higher than expected. But on the Rideau, construction work was to proceed as soon as possible
while the surveying and planning required to form a detailed estimate were being carried on, and the annual appropriations required to support the work underway were to be requested on the basis of the rough preliminary estimate until such time as a proper estimate could be prepared. In effect, Parliament was to be presented with a fait accompli. Once the work was underway and the contracts were signed, Parliament was placed in a position of having either to cover the Rideau Canal expenditures regardless of how high they might be, or to cancel the project by refusing to vote further appropriations and write off all of the monies expended to that date as well as risk being sued for large sums by the contractors. All of this placed the Ordnance in a rather vulnerable position when Lt. Col. By's detailed estimate of November 1827 proved to be greatly in excess of the preliminary estimate submitted to Parliament, and especially so when it subsequently became known that all of the contracts required for constructing the canal had been signed before word reached Lt. Col. By to avoid further commitments. The large increase in the estimate was potentially embarrassing enough, and may well explain the strong reaction of the Duke of Wellington and Major General Smyth in demanding that all of By's plans, his estimate, and his activities be subjected to an intensive scrutiny both in London and on the Rideau. Indeed, they insisted that every effort be made to determine whether the canal could possibly be completed in keeping within the preliminary estimate. Similarly, it might well explain the resistance of the Duke of Wellington and Major General Smyth to By's arguments in favour of constructing a large lock steamboat navigation.

The military advantages of an uninterrupted steamboat navigation were apparent to all concerned, but the added cost in the judgement of the Duke of Wellington and Major General Smyth was totally unacceptable. They believed that Parliament would never acquiesce in the voting of the major sums required to construct the large locks required to pass
steamboats, and so refused to assent to Lt. Col. By's steamboat navigation scheme. But when the Marquis of Anglesey, and then Lord Beresford, succeeded Wellington as Master General of the Ordnance, and William Huskisson replaced Lord Bathurst at the Colonial Office, they were willing to examine By's large lock steamboat navigation proposal on its merits and to empower the Kempt Committee to use its own judgement in authorizing the construction of a larger size lock with the increased expenditures that that would entail. The new men were not as apprehensive as Wellington and Smyth had been about keeping costs within the preliminary estimate, and may well have been far less conscious of the precarious position in which the Ordnance might be placed if costs were to be incurred far beyond anything that had been sanctioned by Parliament.

It is perhaps not without significance that when Wellington recommended, 29 December 1827, that Lt. Col. By's plans and estimate be critically examined in detail and every effort made to find a mode of constructing the canal within the preliminary estimate figure, he no longer occupied the position of Master General of the Ordnance with a seat in cabinet. He was out of government. In contrast, the Marquis of Anglesey, and later Lord Beresford and Secretary Huskisson, when they addressed the large lock question were members of governments, and therefore could countenance increases in expenditure. Indeed, Beresford and Huskisson were appointees of the Wellington government formed in January 1828; and the fact that Wellington thereafter occupied the position of first Lord of the Treasury, as well as that of Prime Minister, probably accounts in large measure for the willingness of the Beresford and Huskisson to examine the merits of By's large lock steamboat navigation proposal despite the additional costs it would entail. Be that as it may, the transformation in Wellington's position may also account for the willingness of the Lord Commissioners of the Treasury to
accept the augmented estimate that the Kempt Committee forwarded to them in November 1828. At any rate, their acceptance of the large increase in the estimate Rideau Canal estimate from £169,000 to £558,000 averted one potentially embarrassing crisis for the Ordnance; but where the estimates were concerned, several difficulties remained to plague the project.

Although the Kempt Committee had instructed Lt. Col. By to limit Rideau Canal expenditures to £105,000 during 1828, they had done nothing to relieve him of any of the contracts let by the Commissariat Department in February 1828. These contracts covered almost all of the work to be performed on the canal, and stipulated that it was to be completed in two years with payment to be made as the work progressed. The contractors had agreed to By's offer of a one year extension in the termination date of their contracts, but had refused to accept any limits on their rate of progress. Consequently, Lt. Col. By had had to inform his superiors at the close of the year, that he still had no control over his expenditures. During 1828, By did manage to keep his disbursements slightly below the authorized expenditure, but by the close of the following year, he had expended a total of £349,264.13.2 on the project, some £52,598.13.2 more than what had been voted by Parliament to cover his expenditures to that date. Moreover, Lt. Col. By reported that increasingly heavy expenditures would be incurred in 1830 as the contractors, thoroughly alarmed at the terrible effects of the outbreak of lake fever in the late summer and fall of 1828, had pressed on the work at a rapid pace when possible in 1829 and during the winter months were exerting themselves to the utmost to do the same in the coming year. Nonetheless, By informed the Ordnance in his progress report of 31 December 1829, that as the work was by then three-fifths finished and roughly two-fifths of his £576,757.14.9½ estimate remained to be expanded, he was satisfied that the Rideau Canal would be completed with only
a slight increase on the estimate. At the same time, in response to an earlier request from the Ordnance as to whether the £576,757 figure, or the £558,000 Kempt Committee estimate, was the working estimate for the project, By stated that he had never been made aware of the latter figure, and proceeded to qualify his 1828 estimate:

At the same time, I respectfully beg to observe, these calculations must not be considered as the positive sums required; for although myself and officers are using every exertion to bring them as near the sum required as possible, yet the clearing and deepening of various parts of the River, Cranberry Marsh and Lake, as also clearing and deepening Cataraqui Creek, and the excavation of the Isthmus Rideau Lake, are services so interwoven with unforeseen contingencies, that the expenses of them must remain uncertain until they are completed; and the utmost that can be done is, to state the probable sum that will be required.

The June 1828 estimate, as Lt. Col. By made clear to the Ordnance, was by no means to be regarded as a final and absolute figure for the cost of the Rideau project. It was at most a reasonable calculation of the probable cost barring any unforeseen difficulties. Moreover, By explained that in the course of construction, costs might well escalate at some of the lock sites, thereby necessitating additional expenditures:

I beg further ... to state, that I complained to the [Kempt] Committee, as I went through the line of Canal with them in 1828, that it was impossible to form a correct Estimate in an uncleared country; and that it was utterly impossible to state whether invert arches to the various locks would be necessary until the
excavations were made. It was also impossible to foresee what difficulties would arise from the water during the construction of the various locks, dams and waste-weirs [sic]; and the Committee then agreed with me, that all I could do was to keep the expense of each work separate, so that my Progress Report would show where and from what causes the excess or saving in Estimate arose. To this I have paid strict attention, as I trust will appear by referring to my Progress Report herewith annexed.\textsuperscript{141}

In retrospect, it is quite obvious why Lt. Col. By chose to re-iterate his earlier warnings to the Ordnance that the 1828 estimate might well be subject to increases. He was becoming aware at this point that the estimate might well be exceeded, and was preparing a detail report on that subject. On 15 March 1830, Lt. Col. By forwarded a supplementary estimate to the Ordnance which comprised a comprehensive statement of all projected costs for the Rideau project including an anticipated cost overrun on his 1828 estimate, the cost of extra works which it now had become apparent were required to complete the canal, and the estimated cost of the measures that the Kempt Committee Report had recommended be undertaken for the defence of the canal.

In his March 1830 progress report, Lt. Col. By informed the Ordnance that his expenditures on canal works would amount to £113,848.16.2½ more than the estimate given to the Kempt Committee; but only £30,124.8.9 of that sum constituted a cost overrun on the items in the estimate. The bulk of the additional monies required, some £83,714.7.5½, consisted of expenditures required for new works the necessity of which was not foreseen by either Lt. Col. By or the Kempt Committee when the 1828 estimate was framed. The latter sum was required for the building of waste weirs at each of the dam sites and the enlarging and
raising of the dams to prevent water flowing over them.142 The original concept of having the overflow dams serve a dual purpose of acting to maintain the water levels as well as carry off surplus water had had to be abandoned when it became evident in 1829 that flood waters falling over several of the relatively low dams completed to that date were of sufficient force to tear up both the back of the dams and the bedrock beneath.143 (Lt. Col. By had also discovered an error in the addition of the 1828 estimate of £2,843 which meant in effect that £116,686 more would be required than the figure given the Kempt Committee in 1828.) The relatively minor cost overrun and the major cost of the new structures, when added to the corrected figure for the 1828 estimate, revealed that £693,449.11.10¼ would be needed to complete the canal works. Furthermore, Lt. Col. By pointed out that if the defence measures recommended by the Kempt Committee were to be carried out, they would demand an additional £69,230. This would cover the purchase of the land required for military purposes, the building of a blockhouse at each of the 22 lock sites, and the excavation of a combination wet ditch-reservoir at the head of the first 8 locks to strengthen the defences there, as well as the building of 15 bridges to restore or open new communications across the canal. If the military works and bridges were authorized, the total cost of the Rideau project would be £762,679.11.10½.144

When Col. Durnford, the Commanding Royal Engineer in Canada, forwarded Lt. Col. By's supplementary estimate to the Ordnance, he enclosed a covering report, dated 24 April 1830, in which he related that he had carried out a minute examination of each item of expenditure proposed in the 1828 estimate and of all expenditures up to 31 December 1829, and could attest to their necessity. The waste weirs were absolutely necessary for the security of the dams; but the erection of blockhouses and the purchase of lands for military purposes might well be postponed. With respect to the new estimate, he added:
It is but mere justice to Lieut. Colonel By to observe, that in water-works of such magnitude and variety, the usual allowance for contingencies appears to the inadequate, and that casualties may yet be expected, over which he can have no control; one of which, sickness, has already been a serious obstruction, and consequent cause of increase of expense, having rendered it necessary to prosecute excavations to a great extent, both of earth and rock, during the winter; so that too much reliance should not be placed even on this present heavy Estimate, which may yet be expected to be exceeded by several thousand pounds; but should this happen, General Mann may rely on it not being attributable either to Lieut. Colonel By, his officers or contractors, of whose unremitting assiduity and perseverance I cannot speak too highly; and, as I have before reported, the whole of the works appear to be executing in the most substantial manner.\textsuperscript{145}

In support of the supplementary estimate, Lt. Col. By on 30 June 1830 forwarded an abstract of a more detailed report then in preparation in which he gave a breakdown of the expenditures at each lock site in the form of a listing of the 1828 estimate for the works at the site, the money expended there up to 30 June 1830, and the probable cost of completing the works, and the excess of expenditure over the estimate where applicable together with a brief explanation of why the excess had been or would be incurred.\textsuperscript{146}

This report was followed by a minutely detailed account, dated 14 January 1831, in which By listed the items totalling £2,843.3.5\textsuperscript{a} that had been error on the 1828 estimate calculation, accounted in detail for the £30,124.8.9 excess on the 1828 estimate, explained where and
and for what purpose additional costs, totalling £83,714.7.5, would be incurred as a result of the decision to construct waste weirs on the Rideau Canal, and provided a detailed explanation of the state of the works at each lock site, the change made in the layout of the structures there, if any, and why they were made. An appendix to this report included copies of numerous letters exchanged between Lt. Col. By and various land proprietors which showed the efforts being made and the difficulties encountered by Lt. Col. By during the past year in attempting to settle claims for lands drowned or damaged in the carrying on of the construction work. In all, By's detailed report, including several appendices, consisted of over 300 pages and included some 500 items by way of explanation and support of his supplementary estimate of March 1830. By added to this massive report a more general defence of his original June 1828 estimate:

I beg in conclusion to remark, that the original Plan and Estimate were formed from as correct data as could be obtained during the period that the woods and swamps were uncleared, and in consequence of their impenetrable nature; many of the surveys required had to be taken during the severity of a Canadian winter, and when these circumstances are taken into consideration with the additional fact that from the country being so extremely unhealthy, nearly all my Officers, Clerks of Work and Overseers, have suffered from repeated attacks of sickness, caught whilst in the performance of their respective duties, it will not, I think, appear so much a matter of surprise that the Plans and Sections have in some instances proved to be incorrect as that so few errors have taken place.
The Ordnance, however, did not have this document, or the 30 June 1830 abstract, in hand during the summer of 1830 when action was taken to inform the Treasury of the supplementary estimate.

The Ordnance decided to postpone the military works, and to order an investigation to determine whether the number of bridges and the reservoir to be built could be reduced in number and size, respectively, and orders were sent to Col. Durnford to thoroughly investigate the necessity of the items in the new supplementary estimate as well as the bridge and reservoir questions. The necessity of the additional expenditure for waste weirs was accepted for the moment as well as the excess of expenditure on the work completed to that date. In informing the Treasury, 17 August 1830, that the new estimate for the Rideau Canal project would be £693,449, Sir Alexander Bryce, General Mann's successor as Inspector General of Fortifications, and the Board of Ordnance expressed their regret that the need for additional works (the waste weirs) had not been foreseen, but remarked that an excess of £30,124 on such a large sum as £349,000 expended to that date in prosecuting works in a veritable wilderness "might not unreasonably have been expected". The Treasury in turn agreed to a supplementary estimate of £693,449 as of December 1830 when the Ordnance was advised "that it appears to my Lords that there has been some informality in the proceedings of Lt. Colonel By, but on the whole he has acted correctly." Henceforth, the annual appropriations voted by Parliament were to be based on the supplementary estimate less what had been voted to that date.

In November 1831, the Ordnance received Col. Durnford's report (dated 15 July 1831) in which he explained that the waste weirs and the By Town reservoir were absolutely necessary, although the latter might well be reduced in size. Moreover, he had examined By's supplementary estimate item by item and could vouch for the necessity of each item
of expenditure contained therein. Enclosed with Durnford's report was a progress report from Lt. Col. By, dated 8 January 1831, and an Abstract of Expenditures of a somewhat later date, the latter of which included a new estimate of the sum required to complete the Rideau Canal. The progress report revealed that £575,551.4.2½ had been expended to the close of the year 1830 (an excess of £138,885 over the sum voted by Parliament to cover disbursements to that date); but otherwise rapid progress was being made and the canal was expected to be completed in August 1831 as scheduled. It also appeared that the canal would be completed in keeping with the £693,449 supplementary estimate, although Lt. Col. By was unwilling to make a definite statement to that effect. His comment on the estimate was that:

as the expence [sic] depends in a great measure on contingencies, the extent of which cannot be exactly ascertained, as they chiefly arise from the immense pressure of water and the periodical sickness, it is impossible for me to report the precise sum that may be required; but at this moment ... I am of opinion that the balance of £117,898.7.7¼ still remaining unexpended ... will prove sufficient to complete this water communication.

Lt. Col. By's caution in addressing the subject of the estimate was fully justified as sometime between the preparation of the 8 January 1831 progress report and the completion of Col. Durnford's report of 15 July 1831 it became apparent that the supplementary estimate would be insufficient to complete the canal. Indeed, in the Abstract of Expenditure submitted with Dunford's report of 15 July 1831, By estimated that the canal when completed would cost a total of £719,074.5.2½, an increase of £25,624.13.4 over the supplementary estimate submitted in March 1830.
necessity of the several works that accounted for the increase and gave detailed explanations of each together with a comment to the effect that there might well be a further increase on the estimate. However, if that were so, he believed it would be trifling as the works were rapidly approaching completion. Although the Ordnance received the package of reports, indicating that the £693,449 supplementary estimate would be exceeded by at least £25,624.13.4, in September 1831, it was not forwarded to the Treasury until 3 February 1832, at which time the Ordnance received a stern rebuke for the delay in forwarding the reports. Furthermore, Treasury Board warned the Ordnance that new regulations, in effect as of July 1831, limited expenditures on Ordnance projects to the parliamentary vote in any given year. Although this placed Lt. Col. By in a potentially difficult situation, the Ordnance inexplicably took no action. Possibly, it was hoped that the increase on the supplementary estimate would be trifling, and therefore inconsequential; but such was not to be the case.

When the expenditures to the close of 1831 were calculated, it was found that £715,408.15.6 had been expended to that date; and Lt. Col. By estimated that a further £60,615.10.0 would be required in 1832 to complete the navigation. The final estimate that Lt. Col. By forwarded to the Ordnance on 27 February 1832 was therefore in the sum of £776,024.5.6. This report was sent to the Treasury in May 1832, and evoked a harsh reaction. For the Lords Commissioners of the Treasury, it was the last straw. They had seen the estimate for the Rideau Canal project, as submitted to them, escalate from £169,000 in 1827, to £558,000 in 1828, to £576,757 in 1829 (following the clearing up of the confusion over whether Lt. Col. By's, or the Kempt Committee's June 1828 estimate was the working estimate for the project), to £693,449 in 1830. Now they were faced with a final estimate of £776,024.5.6, and told
that the canal would not be completed until 1832. What particularly incensed the Treasury Lords was that Lt. Col. By's expenditures to the close of 1831, £715,408.15.6, was £22,742.15.6 in excess of the supplementary estimate of £693,449 accepted by Parliament in 1830 (or more correctly the £692,666 sum that Parliament, rather inexplicably, had actually voted); and that By had gone ahead and expended that money without waiting for authority to do so. (Previously, By had exceeded in all but the first year the sums voted by Parliament to cover his annual expenditure; but his overall expenditure was still within the estimate for the project submitted to Parliament at successive dates. Now, he had gone totally beyond anything authorized by Parliament.) Moreover, the Lords Commissioners noted that Lt. Col. By was clearly making preparations for a further expenditure of £60,615.10.0 in the new year, which would make a total expenditure of £83,358.5.6 beyond the amount authorized by Parliament. This was clearly unacceptable.

It is impossible for my Lords to permit such conduct to be pursued by any Public Functionary. If my Lords were to allow any Person whatever to expend with impunity, and particularly after repeated increases of the Original Estimate upon any work under his Superintendence, a larger amount than that sanctioned by Parliament and by this Board, there would be an end to all control, and My Lords would feel themselves deeply responsible to Parliament. They desire therefore that the Master General and Board will take immediate steps for removing Colonel By from any further Superintendence over any parts of the Works for making Canal Communication[s] in Canada, and for placing some Competent Person in charge of those Works upon whose knowledge and discretion...
reliance can be placed; to whom must be furnished a Statement of the Estimates and Grants and who must be strictly charged upon no account whatever to exceed the amount of the Grant. Furthermore, Lt. Col. By upon his return was to be called upon to provide an explanation for his actions. At this juncture, the Ordnance had no choice but to comply with the Treasury Board Minute of 25 May 1832, and instructions were sent to Colonel Durnford on 1 June 1832 to order the immediate recall of Lt. Col. By.

Fortunately for Lt. Col. By, the Rideau Canal construction project was completed by this time, and had been officially opened when he and his family accompanied by various dignitaries, passed through the canal from Kingston to By Town on the steamboat Pumper (renamed Rideau for the occasion) on the 24-29 May 1832. Thereafter, Lt. Col. By supervised the carrying out of repairs and the organizing of a canal operating establishment until August 1832 when he received word of his recall. As instructed, he placed Captain Bolton, R.E., in charge of the Rideau Canal, and proceeded to Quebec where he and his family departed for London 23 October 1832 on board the transport The Brothers.

When Lt. Col. By arrived in England, he was unable to report on the exact cost of the canal as several repairs were required to take care of the settling of the embankments at various places when the water was let into the canal, and the claims of proprietors whose lands were flooded remained to be settled. However, in February 1833, he was able to report from documents forwarded to him that £777,146.2.0 had been expended on the Rideau Canal works up to 31 August 1832 including the purchase and paying of damages for drowned lands to that date (£10,151.12.6), the building of several blockhouses and bridges (£3,500) and a sum of £241.6.8 still to be paid on the contracts.
Moreover, £11,139.11.5½ had had to be spent on repairs once the water was let into the canal; and it was expected that a further £14,000 would be required to pay compensation to mill owners for damages to, or the purchase of, their mills. (The estimate given the Kempt Committee in 1828 had included a sum to cover this last item; but obviously the arbitration proceedings were resulting in higher awards to the millers than had been expected.) Lastly, perhaps £20,000 might ultimately be required to pay for the wild lands drowned by the raising of the water levels. With respect to the latter, By explained that the Kempt Committee had wanted this item included in the 1828 estimate; but at that time, the Clerk of the Works had estimated it would cost between £14,000 and £16,000 to conduct a survey to determine the extent of land which would be flooded in the swamps and uncleared bush. This expenditure, of course, was out of the question, so the determination of the extent of the drowned lands was left until the waters were raised thereby greatly simplifying the task of computation. Even so, Lt. Col. By reported that the £20,000 estimate could be altered depending on the jury's evaluation of the value of the drowned lands. When all accounts were in, the final cost of the Rideau Canal construction project, as calculated by the Ordnance in January 1834, was £822,804.1.2.

It is not proposed to go into any detail as to the investigation conducted into the Rideau Canal estimates and expenditures after Lt. Col. By's recall. Suffice it to say that he was exonerated after an extended and exhaustive inquiry, but denied the honours which customarily followed completion of an undertaking of the magnitude of the Rideau Canal. His defence was basically that he had never been limited to the expenditure of any specific sum on the Rideau project, with the sole exception of the £105,000 limit placed on his 1828 expenditures by the Kempt Committee. Moreover, he pointed out that the Ordnance was as well aware as he was of the impossibility of either
determining an exact figure for the total cost of the project, or with the contract system in force, of limiting his expenditures in any given year. Indeed, he was under orders to push on the canal construction without waiting for the annual parliamentary grants whatever they might be. With respect to the specific charge that he had expended unauthorized sums of money, Lt. Col. By replied that he had never expended any money solely on his own authority. In November of each year, he had informed the Commissariat Department of his projected expenditures in the coming year, as well as stating the same in his annual progress reports which Col. Durnford forwarded to the Ordnance. His superiors therefore were well aware of what his projected expenditures were for each coming year, and were informed long before the money was actually expended.167 (This latter statement is somewhat misleading and not completely accurate. Each year in his progress report, Lt. Col. By stated what his expenditures in the coming year were likely to be; and his projections were always far higher than what Parliament subsequently voted in the respective annual grant. The difference is accounted for by the fact that Lt. Col. By expected a proportionately large amount of the work to be completed in the first years of the 1828 contracts being in force and calculated his projected expenditures accordingly; whereas the government averaged the successive estimates, less what had been expended to the end of the previous year, over the remaining life of the project to obtain the amount of the annual grant to be voted. Therefore, By's projections of his expenditures for 1829, 1830 and 1831, submitted long before the commencement of construction in each respective year, were much closer to the sum that was actually spent than the parliamentary grants. But even at that, By's cost projections still fell short of the actual sums expended in several years. For example, By's disbursements on the Rideau exceeded his projected rate of expenditure by £59,389 in 1829, and by
£21,184 in 1830; and so technically, monies were spent in excess of the projected annual expenditure figures submitted for the scrutiny of the Ordnance. Nonetheless, with respect to the magnitude of the expenditures that actually were made, By's point was well taken. His cost projections were reasonably close to the sums expended in the following work season; and consequently, the Ordnance was aware of the large amount to be expended. Yet, no effective action was taken either to limit By's obligations or to secure a major increase in subsequent annual grants. Indeed, Lt. Col. By's 1826 instructions to push on the work without waiting for the annual parliamentary grants remained in force, and were being acted on. Thus, the Ordnance had acquiesced in, and in effect approved, both the large expenditure being made by Lt. Col. By and the exceeding of the annual grant year after year. Of course, if the final cost of the Rideau project had been within the £693,449 supplementary estimate accepted by the Treasury, there would have been no problem as the total of the annual grants would eventually have covered that sum.

By maintained that he had informed the Ordnance of his projected expenditures for the year 1831 and 1832 in the same manner as he had previous to commencing construction work in other years; and since his past cost projections had "never [been] disapproved or disallowed" on account of their exceeding the parliamentary grant, he had proceeded to complete the canal in keeping with his instructions. To Lt. Col. By's mind, he had no recourse but to do what he did; and in all his actions, he felt confident that "I have but fulfilled my orders." In his arguments in defence of his actions, Lt. Col. By failed to make the distinction, which Treasury Board had seized upon, between expenditures which exceeded the overall estimate accepted for the construction project, and expenditures that exceeded the annual grant but were still within the overall estimate. The estimate, however, had
been increased in the past once the Ordnance, and more importantly the Treasury, were convinced that the additional expenditure required was absolutely necessary to the completion of the canal, and since this was again the case, By assumed the 1831 increase on the supplementary would be accepted in turn. Moreover, the situation was such that By either had to expend the money or suspend the construction work with the canal incomplete which would have been totally out of keeping with his instructions. In effect, he was caught in a situation where he would have been damned if he expended the money and damned if he did not.
A Broader Perspective

The Role of the Ordnance
Despite the assumption of the Lords of the Treasury to the contrary, Lt. Col. By had no recourse but to expend the additional monies required to complete the Rideau Canal. In so doing he was, as he maintained in a number of missives sent to the Ordnance after his recall, merely carrying out his instructions which set forth how the canal was to be constructed. Nonetheless, the Treasury Lords believed that they had good grounds for censuring Lt. Col. By for failing to limit his expenditures during the year 1831 to the parliamentary grant of that year which brought the total voted for the whole of the Rideau project to roughly the amount of the supplementary estimate of 1830: viz. £693,449.2 This sum had been accepted by the Treasury and Parliament, and had come to be regarded as the final estimate for the Rideau project. When the Treasury received word in May 1832 that By's expenditures in 1831 had exceeded the supplementary estimate by £25,624 and that a further £60,615 would probably be required to complete the canal in the following year, it came as quite a shock despite the forewarnings contained in the several progress reports submitted previously by Lt. Col. By and Col. Durnford, the Commanding Royal Engineer for Canada. The harshness of the censure levelled at Lt. Col. By was but a reflection of their dismay that still a further increase would be required after a series of large augmentations in the estimate for the Rideau Canal project, and more particularly because of development that had taken place during the course of the year 1831.3 However, in condemning Lt. Col. By, the
Lords of the Treasury neglected to take four factors into account: 1) that the contract system adopted for building the Rideau Canal deprived the superintending engineer, Lt. Col. By, of any control over his annual expenditures; 2) that the £169,000 preliminary estimate the Ordnance submitted to Parliament for the project was so unrealistically low as to make a major augmentation in the estimate unavoidable; 3) that the successive estimates submitted for the Rideau project were not all for the same scale of canal; and 4) that the latter estimates commencing with the £576,757 June 1828 estimate, included items, such as the support of the Canal establishment (added to the June 1828 estimate) and the construction of waste weirs (added in the £693,449 supplementary estimate of 1830), which either had not been intended to be carried on the Rideau Canal estimate or had not been foreseen as being necessary, and hence not included in previous estimates. All of this was on record, and well known to the Ordnance long before Lt. Col. By's estimates and expenditures came under attack by the Treasury Board. However, Lt. Col. By's superiors not only failed to come effectively to the defence of his conduct and efforts on the Rideau project; but in effect, they avoided taking responsibility for a situation of their own making.

To expedite construction, the contracts formed for the Rideau Canal project had provided that the contractors were to be paid as the work progressed at a given rate per unit of work performed without limit; and in keeping with that system, as evidenced by the instructions issued for keeping the Rideau Canal accounts whereby the Commissariat was authorized "to make all the periodical payments whatever may be the sum thus disbursed ... whether more or less than the estimated annual grant each year," the Ordnance was prepared to accept expenditures in excess of the annual parliamentary grant in any given year. This no doubt accounts in large measure for the fact that the Ordnance did nothing following the inquiries of 1828 to relieve Lt. Col. By of
any of his contractual obligations despite the fact that expenditures on the Rideau project had exceeded the Parliamentary grant in 1827 and might well exceed the grant in future years, as indeed they did, if steps were not taken to give Lt. Col. By control over his expenditures. In December 1828, Lt. Col. By had complained to a fellow Officer of the unsatisfactory state in which he had been left by the Kempt Committee, and requested that he intercede with the Colonial Secretary, Sir George Murray, to obtain instructions as to what was to be done.

You will scarcely believe that I have not yet received the report of the committee, and had not Sir James Kempt kindly read me that part of which they speak of the Rideau, I should have been perfectly ignorant of their opinion at this moment; and although they authorized me to expend £105,000 in the year 1828, they have given me no instructions to proceed with the work beyond that period, but as my original instructions are not withdrawn, I am making the best arrangements in my power to complete the works by the 12 Aug. 1831. You may therefore surely imagine that I feel neglected, which is not right, for I have used every exertion in my power and have taken great pride in the work, and made arrangements to ensure the completion of it in five years from its commencement, which in the common routine of such extensive works would have taken at least 20 years. Therefore I feel hurt at being so treated for as the Committee have taken no one step to relieve me from any one of the Contracts publicly formed by the Commissariat, I am in the same unpleasant state I was in before they arrived; and my only hope is that you will speak to Sir George Murray and procure me an
Order to proceed with the works; and to act to the best of my judgment immediately; for were I to discharge the men, starvation must take place, and I am convinced it will cost more to stop the works than to finish them without interruption, for if I am to be interrupted by limiting the expenditure, as each contractor will set up claims for damaged;....

But although the Ordnance did act to secure a large upward revision in the annual grant in keeping with Lt. Col. By's June 1828 estimate and his projected expenditures over the next three years, no effort was made to place limits on contract disbursements. To the contrary, both the Colonial Department and the Ordnance were convinced that much higher costs would have been incurred if limitations had been placed on the amount of money to be paid out to the contractors, and continued to adhere to that view. In June 1831, when the Treasury suggested that payments on all contracts, including rather belatedly those in force on the Rideau Canal project, should be limited by the annual parliamentary grant, Sir James Kempt, who had succeeded Lord Beresford as Master General of the Ordnance, had objected:

that unless the Executive Officers at Foreign Stations are authorized to enter into contracts for the whole of any work proposed to be executed in a given number of years, contractors will naturally seek to indemnify themselves by higher prices, from the risk they would run of having their work stopped, or discontinued, at the end of any year.

The Ordnance did not want, in the interests of overall economy, to limit its contracts on large scale multi-year construction projects to the amount of the annual parliamentary grant and was opposed to the adoption of such a regulation. In consequence, Lt. Col. By was not limited
in his expenditures at the inception of the project;\(^8\) and it was soon a matter of public record that under the existing system of construction he had no effective control over his rate of expenditure in any given year.

A select committee of the House of Commons, appointed to examine the accounts and papers relating to the Rideau Canal project, stated in their report 22 April 1831, that the contract system made it impossible for Lt. Col. By to confine his annual expenditures; and that in consequence it was to be expected that expenditures might well outrun the annual grant. Indeed, the committee had been highly critical of the Ordnance for authorizing contracts to be entered into without any stated limits and for keeping Parliament uninformed of what the committee termed such an "irregular and improper practice," and the circumstances that had led to its adoption.\(^9\) The Ordnance, however, did not act to rectify the situation; although Sir James Kempt, during the inquiry that followed the 25 May 1832 Treasury Board censure of Lt. Col. By, did explain to the ministers of the government why By had no control over his expenditures.\(^10\) But this was too little, too late. Whatever, its past failings, it was the failure of the Ordnance to approach the Treasury Board in the summer of 1831 with a frank explanation of the impossibility of restricting the annual rate of expenditure on the Rideau Canal to the amount of the parliamentary grant that, following several developments emanating from the Select Committee Report of April 1831 exposed Lt. Col. By to the censure he ultimately received.

In their report, the Select Committee recommended, on the basis of the Rideau Canal experience, that four regulations be adopted by government to enable Parliament to exercise a firm control over expenditures;\(^11\) and Treasury Board, after consulting with various departments of government, overruled the objections the Ordnance had to placing expenditures limits on contracts and on 8 July 1831
imposed the four regulations on the Colonial Department, the Admiralty, and the Ordnance. The Treasury insisted that henceforth: 1) no works were to be undertaken in the colonies until detailed plans and a proper estimate had been prepared; 2) no monies were to be requested for a project until the said plans and the estimate were submitted to Parliament for perusal; 3) that on multi-year projects, a statement must be submitted to Parliament each year, before the annual vote, setting forth the sums voted and the money expended to that date, all outstanding obligations, and any contemplated additional works, expenditures, or deviations from the original plan; and 4) that all contracts entered into were to be subject to the limits of the annual parliamentary grant unless otherwise authorized by a Minute of the Treasury Board which must be communicated directly to the House of Commons. Although based on the experience of former years, and the on-going reports of Lt. Col. By and Col. Durnford, there was good reason to expect that the contracts long since in force on the Rideau Canal project might well necessitate expenditures in excess of the parliamentary grant for 1831, the Ordnance did nothing to apprise the Treasury Board of that possibility to seek approval to exceed the grant if required to finish the canal. Under the circumstances, some such approach was called for to gain an exemption for the Rideau Canal project. On the other hand, the Ordnance did not even inform Lt. Col. By of the sum voted for the Rideau project for 1831. When queried on this subject by the Treasury Board in February 1832, the Ordnance maintained that it was the responsibility of the Colonial Department, which was carrying the Rideau Canal project on its estimates, to inform By of the annual vote; whereas the Treasury insisted that it was the responsibility of the Ordnance to have kept By informed. Whatever the case, the Lords of the Treasury were grossly unfair in holding By responsible for expenditures in excess of the 1831 parliamentary grant when
he had not been informed of the amount of that grant, or
most likely of even the existence of the new
regulations.\textsuperscript{15} When the treasury issued their Minute of
25 May 1832 censuring Lt. Col. By for failing to limit his
expenditures to the 1831 parliamentary grant, they were
enforcing what was in effect an \textit{ex post facto} regulation as
the Rideau Canal contracts were in force three years before
the new regulations were adopted. The Ordnance might well
have taken up this point, but did not.

The Ordnance, one would assume, had good grounds for
claiming an exemption to the new regulations in view of the
terms of the contracts already in force on the Rideau Canal
project; but the failure to do so left no recourse open
except to hope that Lt. Col. By's expenditures would fall
within the amount of the 1831 grant which brought the total
sum voted up to the supplementary estimate of £693,449
accepted by Parliament in 1830. The Rideau project was
scheduled for completion on 31 August 1831, and apparently
progressing on schedule, and the communications lag between
London and the Rideau was such as to preclude Lt. Col. By
being informed of the new July 1831 regulations prior to
that date. Moreover, the Ordnance Department was well aware
that even if word could have been got to Lt. Col. By while
construction continued, the bulk of the work on the Rideau
Canal was covered by existing contracts, and if limits were
imposed on expenditures at that late date, it would not only
involve the Ordnance in law suits for heavy damages on
behalf of the contractors,\textsuperscript{16} but would probably result
in the work being suspended before the canal could be
completed. Some such considerations as this might well
account for what otherwise is inexplicable: viz. the failure
of the Ordnance to issue any additional instructions to Lt.
Col. By to take account of the new regulations imposed in
July 1831. Likewise, it would help explain why the Ordnance
held back several Rideau Canal progress reports from the
Treasury Board. On September 3, 1831 the Ordnance received
from Lt. Col. By an Abstract of Expenditures in which he stated that it would require at least £25,624.13.4 more than the supplementary estimate approved by Parliament to complete the canal. This was followed by a report from Col. Durnford, dated 15 July 1831, which attested to the absolute necessity of the additional expenditures and stated that even that sum might well be exceeded. This was the first indication that the supplementary estimate, and the annual grant for 1831 based on that estimate, would be exceeded; yet these documents were not forwarded to the Treasury Board until 3 February 1832, much to the annoyance of the latter.17

The Ordnance may well have withheld the reports from the Treasury Board in the expectation that a final report would arrive any day from Lt. Col. By informing the Board of the canal's completion and the final cost of the same at which point the Treasury could have been approached with a firm figure for the cost of the canal. However, such a report was not received from Lt. Col. By during the fall and early winter of 1831-32, and by February 1832 the Ordnance apparently decided that the Treasury Board could no longer be kept uninformed of the projected 1831 cost overrun.

Whatever the motives of the Ordnance, it is clear in retrospect that had the 1831 regulations been in effect in 1826, or had the Ordnance respected the accepted practice governing the initiation of major capital works projects, the Rideau Canal project would not have been undertaken in the way it was; and Lt. Col. By would have been spared the censure that he received in 1832 for his disbursements outrunning the parliamentary grant. In addition, the unrealistically low preliminary estimate, which was to plague Lt. Col. By, would never have been brought forward.

At the time of his appointment to superintend the Rideau Canal project, Lt. Col. By had objected that the preliminary estimate was totally inadequate on the basis of a comparison of the scale of the Lachine Canal as contrasted
with the scale of the projected Rideau Canal and the cost of the former; but the Ordnance continued to adhere to that figure during the early stages of the Rideau project in what may well have been a deliberate attempt to mislead Parliament. The Select Committee of 1831 after investigating the large sums of money being expended on the Rideau Canal, charged that the project had been undertaken in haste by the Ordnance without the consent of Parliament, or a Minute of the Treasury Board; and that work thereon had been authorized, and open ended contracts providing for payment independent of the annual parliamentary grant were entered into, without any estimate of the cost of the project being submitted for approval. In consequence, Parliament could only have assumed that the £5,000 voted in 1826 was in support of some preliminary measures to be carried out by Lt. Col. By on the Rideau. Moreover, when an estimate for the Rideau Canal was finally submitted to Parliament on 22 May 1827, it was the preliminary estimate of £169,000 at a time when the Ordnance already had in hand two reports from Lt. Col. By remonstrating against the inadequacy of that sum in addition to his initial comments questioning the preliminary estimate on the basis of comparative costs with the Lachine Canal project. Moreover, the Committee also noted that the estimates for the Rideau and the Ottawa canal projects had undergone a series of upward revisions. The three Ottawa canals, when assented to by the Treasury Board in August 1819, were supposed to have cost £16,740 with one-half that sum to be paid by the provincial legislature; and yet by 1823, the estimate was increased to £49,000 for the Grenville Canal alone with the mother country being expected to bear the total cost. Thereafter the Smyth Report of 1825 estimated the total cost of the Ottawa canals, including a lock at the Ste. Anne's rapids, at £110,000, and a further increase took place in November 1828 when it was estimated that all three Ottawa canals could be completed for £176,540. This was increased
again in 1831 to £285,367. On the Rideau Canal, a similar escalation in the estimates took place. Parliament was informed for the first time on 22 May 1827 that the Rideau Canal would cost £169,000, and then informed in 1828 that it would cost £527,844 (Huskisson's figure based on By's November 1827 estimate for constructing 20 foot wide locks, with the addition of £50,000 to cover the cost of enlarging the locks and £3,000 to cover work lost in converting to a larger sized lock). This sum was increased afterwards to £576,757 (By's estimate of June 1828 for constructing the approved lock); and then again in August 1830 to £693,449 (the supplementary estimate). In view of these developments, and similar experiences on other military works, the Committee charged that the military authorities had acted deliberately to entrap Parliament into paying for large scale projects by presenting the members with a fait accompli. In other words:

The various works were begun and moderate sums were called for from year to year; the grant of every former session became a reason for granting more in the succeeding session, in order that the first sum might not be expended in vain or the work left incomplete.

Whether deliberate or not, the Ordnance under the previously ill-defined system of financial responsibility and divided authority was able to give credence to an unrealistically low estimate for Rideau project and obtain funds for prosecuting its construction without parliament being aware of the true potential cost of the undertaking. This not only placed Lt. Col. By in a position where his detailed estimate would invariably greatly exceed the preliminary estimate, but cast any major increases made thereafter in a very bad light. The situation was further exacerbated by the fact that neither the Select Committee of 1831, nor the government in the investigations that followed the censure levelled at Lt.
Col. By in 1832, took the time to peruse and evaluate the reasons for the successive increases in the Rideau Canal estimate. Indeed, contemporary critics focused their attention on the large discrepancy between either the preliminary estimate, or By's first estimate, and the final cost of the project to the detriment of Lt. Col. By's reputation, and criticism has continued to be levied against Lt. Col. By on the basis of those figures. Yet paradoxically, with but two exceptions, at no time has Lt. Col. By been accused of extravagant expenditures.

Until he suffered a seizure at home in 1834, Lt. Col. By was subjected to a continuous questioning on the subject of his accounts; but despite two years of intensive examination the Treasury was unable to uncover any financial irregularities or cite any instances of extravagant expenditure and with good reason. During the whole period of construction, Lt. Col. By had submitted a series of itemized, thoroughly detailed, progress reports setting forth the original estimate for the work at each site, the monies expended on it to date and the amount required to complete the work, together with a statement of where in each case savings had been made or excesses incurred and an explanation for each. Indeed, his progress reports were well in keeping with modern engineering practice, and far in advance of the general practice of the time. Moreover, the Bryce Committee in January 1828 had subjected By's early reports to a careful scrutiny to ascertain the practicability and economy of By's plans and projected expenditures; and the Kempt Committee had investigated By's work and expenditures on the spot in June 1828. Thereafter, Col. Durnford, the Commanding Royal Engineer, Canada, had investigated and examined on the spot, under strict orders from the Ordnance, all additional works proposed by Lt. Col. By and had attested to their absolute necessity. After examining the Rideau Canal accounts, the Select Committee of 1831, as mentioned, was highly critical of the Ordnance for
adopting the contract system employed on the Rideau and for the way in which the project was commenced, but made no criticism of Lt. Col. By's conduct or his expenditures; and a second Select Committee in their report, dated 29 June 1832, also did not question the necessity of the expenditures made by Lt. Col. By. Even the Treasury Board, which was very hostile toward Lt. Col. By during the course of their investigations, was unable to sustain any charges against him for extravagance or misapplication of funds. The 1832 Select Committee report did however criticize Lt. Col. By indirectly by expressing the belief that Lt. Col. By's estimates were totally unreliable as a guide to the cost of the Rideau project, or any other project that he might submit an estimate for, and expressed surprise in view of the regulations imposed by Treasury Board on 8 July 1831, that Lt. Col. By had not kept his expenditures within the amount of the 1831 grant. In contrast, the report lauded the engineering establishment constructing the Ottawa River canals which had kept its expenditures within the 1831 grant. The latter comment, of course, ignored the fact that the Ottawa canals were being constructed on the day work system where work could easily be suspended when funds were used up; as opposed to the contract system in use on the Rideau Canal which the previous Select Committee Report had noted gave Lt. Col. By no control over his expenditures. In addition, the Committee apparently did not realize that Lt. Col. By remained under orders to push the Rideau Canal project to a conclusion as quickly as possible; whereas the Ottawa establishment was under no such orders. To the contrary, the Ottawa canals which at the commencement of construction in 1819 were expected to be completed in six years at a total cost of £16,740 were still under construction in 1831 when the Select Committee of that year reported that £285,367 had been expended to that date. The Select Committee of 1832 cited the
escalating costs of the Ottawa River canals, but did not take that into account when viewing the Rideau Canal estimates nor did they investigate how the successive increases in the Rideau Canal estimate had come about or how the cost of the Rideau Canal compared with other canal construction projects of a similar nature and magnitude. Rather, both select committees concentrated on how large expenditures such as had been made on the Rideau Canal project might be better controlled by Parliament in future through a reorganization of Departmental responsibilities and the imposition of new financial regulations. In consequence, the Reform government despite the lack of any specific charge of wrongdoing made against Lt. Col. By, was left with the impression that he somehow was responsible for the heavy expenditures incurred on the Rideau Canal. The government was apparently prepared to accept the necessity of By's first estimate of £474,844 over Smyth's preliminary estimate of £169,000; but as Lt. Col. By related to Lord Dalhousie:

the present Ministers have not read my reports stating the necessity of the additional Works, they appear to think I have acted without authority, and evidently wish to throw the blame of the heavy expenses on me, whereas the works speak for themselves; and it is admitted by all who have examined them that they are equal to any in the world and are 25 per cent cheaper than any work of the kind in North America. I therefore trust it will not be long before the Government will be made sensible that they have cast an undeserved censure over one of their most zealous & deserving servants, and adopt some measure to relieve me from the heart rending sensations that censure has occasioned.
But By's hopes were ill-founded. The failure of the Select Committees to place the Rideau Canal expenditures in a broader context vis-a-vis the cost of other construction projects, and to examine into the reasons for the successive increases in the Rideau Canal estimates, left Lt. Col. By's competence open to question in the eyes of the government. This was a significant oversight for had the committees done so, they would have realized that By had not only been cost conscious, but under exceptionally trying conditions, had prepared reasonably accurate estimates for the items covered in each of the respective estimates.

With respect to the Rideau Canal estimates, it appears that the Select Committee of 1832 was led to question Lt. Col. By's competence simply on the grounds that he had submitted during the course of construction a series of estimates, five in all, for increasingly large sums of money; and yet the final cost of the project, £822,804, was not only far in excess of By's first estimate of £474,844 but also in excess of the last estimate approved and accepted by Parliament: viz. the supplementary estimate of 1830 in the amount of £693,449. Here was seemingly a damning indictment of Lt. Col. By's competence as an engineer; but a more careful examination of the figures would have revealed a different view.

In the first place, By's initial engineering estimate of £474,844, submitted in November 1827 was for the construction of a gunboat navigation with locks 20 by 108 feet and covered only the building of the canal works proper exclusive of the cost of the military establishment required to build the canal. When the Kempt Committee decided that a steamboat navigation should be constructed with locks 33 by 134 feet, Lt. Col. By accordingly submitted a second estimate, that of June 1828, in the amount of £576,757 to cover the additional monies required to increase the lock size and support the Rideau establishment which he had been informed was not going to be carried on the Extraordinaries
on the Army as he had expected. This estimate, as By explained at the time, did not include any provision for the purchase of land and the building of fortifications required for the defence of the canal and because of the magnitude and complexity of the work underway might well have to be increased to meet unforeseeable contingencies. The third estimate, the £693,449 supplementary estimate of March 1830, was submitted principally to cover the cost of the waste weirs (£83,714), which had been found necessary to protect the dams in time of flood, and a cost overrun of £30,124 on the 1828 estimate. By the spring of 1831, a fourth estimate in the amount of £719,074 was submitted to take care of a £25,624 cost overrun on the supplementary estimate; and, when it became clear that the canal could not be completed as scheduled in August 1831, Lt. Col. By submitted an abstract of a fifth estimate in February 1832 of £776,024.5.6 to cover his projected expenditures in 1832. This estimate, however, was re-worked in greater detail on 5 March 1832 when several additions were made which brought the final estimate for the project to £803,774. The £803,774 estimate included an allowance for two items that had not been on any previous estimate: viz. £20,000 for the purchase of lands for military purposes and £9,080 to be expended on constructing several blockhouses and bridges, as well as a £14,000 addition to the sum that had been allowed in the June 1828 estimate to cover the projected claims for property damages caused by the raising of the waters. The failure to include the military items and bridge construction costs, as well as a sufficient estimate for providing compensation for property damages, in earlier estimate, was by no means due to any oversight or miscalculation on the part of Lt. Col. By.

The Kempt Committee in their report of June 1828 made it clear that the £576,757 estimate for the construction of the 33 by 134 foot locks on the Rideau Canal did not include any provision for its defence, and that Lt. Col. By was to
prepare an additional estimate to cover the cost of the lands needed for military purposes and the military structures to be built as soon as he determined precisely what was required for the defence of the canal. In March 1830, when Lt. Col. By submitted his supplementary estimate of £693,449 for the construction of the canal, he appended an additional estimate in the amount of £69,230 to cover the costs that would be incurred in purchasing land for military purposes and building 22 blockhouses and a wet ditch-reservoir at communications across the canal. The Ordnance had accepted the supplementary estimate for the canal works, but decided to postpone any action on the military works until after Col. Durnford had determined if the bridges and the wet ditch-reservoir to be constructed could be reduced in number and size, respectively. Therefore none of these items were included in any of the estimates submitted to the Treasury Board prior to that of February 1832 in which Lt. Col. By submitted that it would cost a total of £29,080 to construct a greatly reduced number of blockhouses and bridges and purchase the lands required for the former. An allowance was made in the June 1828 estimate, and subsequent estimates, to cover potential claims for property damage caused by the raising of the waters in the canal; but the amount inserted in the estimates was never intended to cover the whole of the liability to be incurred.

The Kempt Committee had wanted all of the costs of the potential property damages to be caused by the raising of the canal waters to be calculated and included in the June 1828 estimate prepared by Lt. Col. By for the 33 by 134 foot lock scale of canal; but to have surveyed and levelled the low lying lands on the edges of the meandering rivers, extensive swamps and march lands to determine the extent of the drowned lands prior to the raising of the waters was deemed to be too expensive and time consuming to enable such an estimate to be made. Indeed, it was calculated that the

surveying costs alone would run somewhere between £14,000 and £16,000 for such a demanding undertaking. In consequence, it was decided to wait until the waters were raised to determine the full extent of the flooding and the damages that might have to be paid.\textsuperscript{37} The June 1828 estimate did make an allowance for compensation to be paid to property owners for damages, but it was intended to be but a partial estimate barring the determination of the full extent of the damages. Unfortunately, neither Sir James Kempt nor Lt. Col. By made this understanding clear when submitting the June 1828 estimate and their respective comments on the same; and the Ordnance was inadvertently given the impression that the £8,500 and £662.2.6 items of projected expenditure included in the June 1828 estimate to provide compensation for damages to mill owners and land owners, respectively, were for the full extent of the potential damages to be incurred.\textsuperscript{38} This matter was not cleared up until February 1833 when Lt. Col. By, in response to a query from Ordnance during a post-construction inquiry into the Rideau Canal estimates explained the understanding reached with the Kempt Committee on the necessity of an incomplete estimate for property damages pending the raising of the water levels in the canal.\textsuperscript{39} By the time that Lt. Col. By submitted his final estimate of February 1832, the waters had been raised in most of the stretches of the canal and the extent of the drowned lands could be readily determined. Hence his insertion in the new estimate of the figure of £14,000 which he believed would probably be required to cover the outstanding property damage claims; but the Ordnance should have been aware that even after the extent of the drowned lands was determined, any estimate provided for the potential cost of property damages was at best a very rough guess as to what the eventual liability would be.

From almost the commencement of the Rideau Canal project, Lt. Col. By had explained the serious problems
experienced in attempting to purchase the lands required for the Rideau Canal at a fair evaluation; and the terms of the Rideau Canal Act, which empowered Lt. Col. By to expropriate the lands required for the canal, further hampered him in determining what compensation would have to be paid for the lands expropriated or damaged by the raising of the canal waters. The Rideau Canal Act passed by the provincial legislature in February 1827 stipulated that:

[in estimating the claim of any individual to compensation for property taken, or for damage done under the authority of this Act, the Arbitrators or Jury assessing such damages shall take into their consideration, the benefit likely to accrue to such individual from the construction of the said Canal, by enhancing the value of his property or producing other advantages; and the arbitrators were not to be appointed until the canal was completed. In effect, even when the extent of the land to be expropriated or flooded was known, there was no way that Lt. Col. By could have established what the valuation of the land in question would be prior to the completion of the canal. He was, of course, at liberty to purchase the lands in question if any individual was willing to sell at a fair price; but the demands made by the proprietors were often exorbitant. For example, Nicholas Sparks, from whom Lt. Col. By expropriated 88 acres at By Town in the spring of 1827, demanded £600 per acre in compensation when the whole of his 200 acre property and the house thereon had cost him only £85 when purchased in 1823. In a number of cases, Lt. Col. By was able to acquire the land required for the canal at a reasonable price, from landowners who were making exorbitant demands for but a section of their property, by the expedient of offering to purchase the whole of the individual's estate and granting him a 30 year lease on the part of the property not required...
for canal purposes at an annual rent of 5 per cent of the purchase price. In this manner, Lt. Col. By was able to avoid claims for damages which were generally double what he had to pay for the whole of the property under the lease back system. Nonetheless, where landowners persisted in pressing exorbitant damage claims, it was impossible to make any adequate provision in the Rideau Canal estimates even after the extent of the damage had been determined by the raising of the canal waters. An exact figure for damages could only be determined after the arbitrators had made their assessment of the amount of damages to be paid; and the arbitrators could not be appointed until the canal was completed. Thus, even in his final estimate of March 1832, almost six months prior to the completion of the canal, Lt. Col. By was still not able to provide a precise, absolute estimate for the amount of compensation that would have to be paid for property damages, and hence could not provide the Ordnance with a fixed figure for the cost of constructing the Rideau Canal.

In viewing the succession of estimates submitted by Lt. Col. By for the Rideau Canal project, the Select Committee of 1832 and the Treasury Board could not comprehend why each estimate right up to almost the completion of the canal represented a major augmentation in cost over the previous estimate; and it was concluded that Lt. Col. By was incapable of forming a reliable estimate no matter how well he may have superintended the actual construction work. Both the Treasury Board and the members of the parliamentary committee assumed that each estimate was for the total cost of the canal, an absolute fixed figure, despite Lt. Col. By's comments in his reports as to the impossibility of arriving at any fixed or positive figure for the Rideau Canal given the numerous contingencies to which such a large scale project, conducted under the most trying of circumstances, was subject. In addition to the problem of arriving at any fixed figure for the compensation to be paid
for the drowned lands and lands required for canal purposes, Lt. Col. By had to cope with the almost insurmountable problems of surveying and levelling over great distances in virtually impenetrable swamps, and a debilitating sickness (malaria) which brought work to a standstill for months at a time and forced Lt. Col. By to resort to costly and difficult winter excavation work, and absorb the additional costs incurred to avoid working during the sickly season. Moreover, much of the excavation work had to be carried on in areas where a great deal more rock excavation was encountered than had been expected. Costs were also inflated where contractors succumbed to sickness at several of the more unhealthy sites on the canal, and at other sites where the contractors left the scene once it became apparent that the rate at which they had contracted to do the work was insufficient to cover their costs. At the sickly sites, Lt. Col. By was forced either to take over the work from the deceased contractors and pay exceptionally high wages to day workers to encourage them to apply for employment, or he had, in at least one instance, to almost double the price for the work underway where sickness was rife. Where the contract price had proved too low to cover the costs incurred in doing the work, as in the case where good building stone was not found as close to the work site as expected, the contract price had to be increased for the contractor. Indeed, on the whole of the Rideau Canal project only four of the initial eighteen major contractors completed their work in keeping with the terms of the contract; and the contributions of these men to the successful completion of the Rideau Canal project was publically recognized by Lt. Col. By. However, in the numerous instances where contractors either succumbed to sickness or abandoned the work to avoid bankruptcy, Lt. Col. By was forced to absorb costs far beyond the original contract price on which he had based his June 1828 estimate for the construction of a steamboat navigation with 33 by
134 foot locks. All of the excesses in expenditure caused by the above contingencies at the various canal works were carefully documented in the progress reports which Lt. Col. By had continued to forward to the Ordnance. Had the parliamentary committees and the Lords of the Treasury Board taken the time to peruse Lt. Col. By's reports, or had the Ordnance pointed out the impact of these various contingencies on the cost of construction, it would have been clear to everyone concerned why Lt. Col. By had had to submit a succession of ever increasingly higher estimates to the Ordnance during the progress of construction. Such an effort would also have revealed that the mere fact Lt. Col. By submitted a series of increasingly higher estimates for the Rideau Canal project did not of itself provide a valid criterion for concluding that he was incapable of forming a reliable estimate.

The reports that Lt. Col. By forwarded to the Ordnance indicate that, with the exception of the fourth estimate wherein a cost overrun accounts for the whole of the £25,624 increase on the previous estimate, only a small portion of the increases made in the series of estimates were directly attributable to a cost overrun in constructing the items included in a previous estimate. For example, the supplementary estimate of March 1830 increased the projected cost of the Rideau Canal from the £576,757 June 1828 estimate to £693,449, but only £30,124 of the £116,692 increase was attributable to a cost overrun in constructing items covered in the June 1828 estimate. A more valid criterion for assessing Lt. Col. By's competence in forming estimates therefore would have been to compare the final cost of the canal works with Lt. Col. By's first estimate for the work that was actually done. In effect, the first estimate for the size of canal works actually constructed, the June 1828 estimate, should have been compared to the total cost of the canal works on their completion, exclusive of the cost of the items not covered in the June 1828
estimate and the various contingencies for which it was impossible to provide anything but a partial estimate. In this manner, the true cost overrun on the estimate for the works actually constructed could have been calculated and Lt. Col. By's capabilities fairly assessed.

The £576,757 June 1828 estimate for constructing the Rideau Canal with locks 33 feet by 134 feet, comprised not only an estimate of the total cost of constructing the canal works but also a partial estimate in the sum of £9,162 to cover the property damage claims (£8,500 to buy out mill owners and a partial estimate of £662,2.6 toward the eventual cost of compensating the proprietors of the lands to be drowned). It did not include any sum for constructing bridges across the canal, blockhouses, or for the purchase of military lands. The actual amount allowed in the June 1828 estimate for the total cost of constructing the canal works proper was therefore £567,595. The amount expended on the Rideau project as of its date of completion on 31 August 1832 (and exclusive, of course, of the property damage claims paid thereafter) was £777,146; but this sum included £10,151 expended in purchasing lands and paying damages, and £3,500 paid out for constructing several blockhouses and bridges. The blockhouses and bridges, as mentioned, had not been included in the June 1828 estimate; and the property payments made to that date were as yet incomplete and not part of the cost of constructing the canal works proper. The true cost of constructing the canal works was therefore £763,146 (£777,146 less the cost of the blockhouses, bridges, and land payments); and when it is compared with the cost estimate formed in June 1828 for the canal works exclusive of extraneous items (viz. the £567,595 calculated above), it yields a difference of £195,551. However of this difference, £83,714 went to build the waste weirs which were additional works not included in the June 1828 estimate as the need for waste weirs had not been foreseen. In keeping with engineering practice,
the monies expended on these additional works cannot legitimately be considered as part of the cost overrun. In sum, the true cost overrun on Lt. Col. By's 1828 estimate was £111,837 or roughly 19.7 per cent for the canal works included in that estimate. Taking into account the peculiar difficulties under which Lt. Col. By had to work in preparing his June 1828 estimate and performing the work thereafter, this overrun in construction costs was by no means of such a magnitude as to justify the casting of aspersions on the competence of Lt. Col. By in the forming of estimates.

All of this would have been readily apparent if Lt. Col. By's estimates and expenditures had been examined in their proper context and the reports read wherein an explanation was provided as to what each respective estimate was intended to cover, together with the reasons for the cost increases, rather than the final total cost of the project being set against, as tended to be the case, Lt. Col. By's initial estimate of £474,844 which was for a smaller scale of canal. In effect, had the Select Parliamentary Committee of 1832 thoroughly investigated Lt. Col. By's estimates and expenditures, his competence would not have been called into question any more than the committee could have gone on record as being surprised that Lt. Col. By had not kept his 1831 expenditures within the amount of the parliamentary grant for that year. The final cost of the Rideau Canal, of course, was £822,804; but again this included items which were either not carried on the £576,757 June 1828 estimate or were costs that could not possibly have been calculated in any meaningful fashion prior to the completion of the canal: viz. the £3,500 expended in building the several blockhouses and bridges; £11,139 spent on repairs occasioned by the natural settling of the man-made embankments following the opening of the canal; and substantial sums awarded by the arbitrators in meeting claims for damages to property caused by the construction of the canal.
Leaving aside the question of Lt. Col. By's competence in forming engineering estimates and the reports of the various parliamentary committees which investigated the Rideau Canal estimates and expenditures, it is obvious that in any calculation of the cost of the Rideau Canal, the £822,804 total cost figure cannot be dismissed out of hand. However, even if the provisions of the various estimates are ignored and a simple comparison is made of the final total cost of the Rideau Canal project (£822,804) with the June 1828 estimate (£576,757) submitted by Lt. Col. By for constructing a steamboat navigation with locks 33 feet by 134 feet, the comparison is not all that unfavourable to Lt. Col. By. The monies expended in excess of the June 1828 estimate, some £256,047, represent an increase of expenditure of 42.6 per cent; but this increase of expenditure over the first estimate submitted for the scale of the canal actually constructed is very close to the cost overrun incurred on the Ottawa canals constructed by the Royal Staff Corps engineers, and in keeping with the magnitude of the cost overruns on other contemporary canal construction projects under the superintendence of highly competent canal engineers. Moreover, it should be borne in mind that the Ordnance, the Treasury Board, and Parliament had approved and accepted the March 1830 Supplementary estimate of £693,499, and the items delineated therein as being absolutely necessary to the construction of the Rideau Canal; and both Lt. Col. By and Col. Durnford, the Commanding Royal Engineer for Canada, had warned that innumerable contingencies might well force the cost of the canal beyond that figure. In such a context, the final cost, £822,804, which represents a cost overrun of £129,344 or roughly 18.6 per cent on the Supplementary estimate over the last two years of the project, should not have been all that surprising.

Lt. Col. By, it is clear, was a victim of circumstances beyond his control which had their origin in the open-ended,
rate per unit of work, contract system adopted by the Ordnance for the construction of the Rideau Canal and the unrealistically low preliminary estimate submitted to Parliament for the Rideau project, both of which the Ordnance adopted by design rather than accident; as well as of the loose, ill-defined, system of financial control which enabled the Ordnance to commence work on a major construction project before the engineering estimate and plans were submitted to Parliament for approval.

Ironically, all of this was known to the Treasury Board in the spring of 1831 when they acted to impose regulations which were intended to prevent such a situation developing as that in which Lt. Col. By found himself on the Rideau project: viz. with expenditures outrunning the annual Parliament grant and locked into a contract system which left him with no control over his rate of expenditure in any given year; and yet the Lords of the Treasury did not follow through on this obvious explanation for Lt. Col. By's failure to confine his expenditures to the Parliamentary vote of 1831 in keeping with the new financial regulations.

The Ordnance on its part, was definitely remiss in failing to explain the reasons why the Rideau Canal contract system could not be altered once the contracts were all in force, and for not seeking an exemption for the Rideau project from the new financial regulations imposed by the Treasury in July 1831. The four new regulations were of an *ex post facto* nature where the Rideau contracts were concerned; and there was a provision in the regulations to the effect that, in special circumstances, Treasury Board could grant permission for expenditures to exceed the amount of the annual parliamentary grant for a project. However, not only did the Ordnance neglect to request such an exemption for the Rideau Canal project, but when Treasury Board attacked Lt. Col. By's expenditures and questioned his competence, the Ordnance failed to prepare any statement explaining why By's expenditures had exceeded the
Parliamentary grant of 1831 in contravention of the new regulations, or any defence of his conduct of the work. The Ordnance had in hand a wealth of testimony attesting to the magnitude of Lt. Col. By's accomplishment on the Rideau: viz. Lt. Col. By's detailed progress reports, the Bryce Committee Report of January 1828, the Kempt Committee Report of June 1828, Col. Durnford's various reports, and a number of lengthy submissions from Lt. Col. By in defence of his conduct, which could have been brought to bear on Lt. Col. By's behalf; and yet it chose not to act. In effect, Lt. Col. By had to suffer for developments which were inherent in the very organization of the Rideau Canal project, and the subsequent failure of the Ordnance to come to grips with the exigencies of the situation following the imposition of the new financial regulations by Treasury Board in July 1831.

Treasury Board, on its part, was well aware from the Select Committee Report of April 1831 that the contract system adopted for constructing the Rideau Canal had deprived Lt. Col. By of any control over his rate of expenditure, and as well knew that the Ordnance was opposed to placing limits on construction contracts. Yet, Treasury Board apparently took no action to determine if the Ordnance had made any effort to empower Lt. Col. By to impose limits on his contractual obligations or to relieve him of some of his contracts. Indeed, this was a crucial and obvious question if it were to be determined who was responsible for the fact that expenditures were made in 1831 in excess of the Parliamentary grant of that year and in contravention of the financial regulations then in force. The failure of Treasury Board to either pursue this matter or to examine Lt. Col. By's report and accounts, lends credence to his charge that the Reform government was determined to let the blame for the large Rideau Canal expenditures fall on him personally. The Reform government had a strong bias against making expenditures on colonial defence projects; and
it was apparently bent on holding someone responsible for the massive costs incurred on the Rideau.

Although the parliamentary investigations, and subsequent inquiries made by the Ordnance into By's conduct and expenditures while superintending the Rideau Canal project, failed to turn up any evidence of wrongdoing, extravagance, or incompetence, Lt. Col. By did not consider that his character and professional reputation had been properly vindicated in view of the charges that had been levelled against him; and he asked the Ordnance to see to it that:

I may be honored with some public distinction as will show that my character as a soldier is without stain, and that I have not lost the confidence or good opinion of my Government.59

The Ordnance, to its credit, recommended that Lt. Col. By should be presented at the Royal Levee as a mark of public recognition for his achievements on the Rideau; but leading members of the Reform government, and the Treasury Board, brought pressure to bear to block By's presentation.60

However, had the Ordnance chosen to prepare a statement in defence of Lt. Col. By's conduct, expenditures and attainments, there was no way that Treasury Board could have continued to hold Lt. Col. By responsible for either the contravention of the 1831 financial regulations or the heavy expenditures on the Rideau project. But to have done so would probably, given the hostile feelings in evidence on the Reform government benches, have turned the wrath of the Treasury Board against the Ordnance itself. Nonetheless, had the Ordnance presented Treasury Board with a detailed statement or a report on how the Rideau Canal project was conducted, together with an explanation of the pertinent facts bearing on the case against Lt. Col. By, his achievement would have spoken for itself and doubly so, had Treasury Board been provided with the means of comparing Lt.
Col. By's accomplishments, and the cost incurred, with that of engineers on other contemporary canal construction projects.

The Rideau Canal and Contemporary Canal Construction Projects

After his return to England, Lt. Col. By submitted a number of lengthy statements to the Ordnance in defence of his conduct in constructing the Rideau Canal. In each of these statements, and in several private letters prior to that date, he asserted that he had constructed one of the finest canals in North America at a cost of anywhere from 15 to 25 per cent cheaper than any comparable work; and what is more, that he had accomplished in six years what in the normal course of construction work would have taken 20 years to complete. What this claim makes obvious is that any attempt to assess the magnitude of Lt. Col. By's achievement, or shortcomings, as an engineer in planning and superintending the construction of the Rideau Canal ought to take into account the performance of military and civil engineers working on other contemporary canal construction projects. Although it is extremely difficult to compare canal construction projects in view of the differences of scale, the wide variety, range, and varying extent of the difficulties to be overcome, and the peculiar problems that may have pertained to the constructing of one canal as distinct from another, nonetheless a meaningful comparison can be made. To that end, a number of contemporary canal construction projects have been selected for examination with respect to the Rideau Canal project: viz. the Ottawa Canals, constructed by military engineers of the Royal Staff Corps (1819-34); the Lachine Canal, constructed under the superintendence of a British canal engineer (1820-1825); the Welland Canal, constructed by American canal engineers (1824-33); and the Caledonian Canal in Scotland, constructed by one of the most proficient of the British canal engineers of the day (1803-22).
When work commenced on the Grenville Canal in 1819, no estimate was prepared for the ultimate cost of constructing the four proposed Ottawa River canals (viz. the Grenville, Chute à Blondeau, Carillon and Ste. Anne's rapids canals). Treasury Board had agreed to the construction of the Grenville Canal section on the basis of a cursory estimate of £16,740,62 and work had proceeded thereafter under the superintendence of Captain, later Lt. Col., Du Vernet of the Royal Staff Corps.63 However, Major General Carmichael Smyth, after visiting the site in 1825, reported that £32,000 had been expended on the Grenville during six years of construction; and he estimated that it would cost a total of £110,000 to complete all four of the Ottawa canals (£60,000 for the Grenville; and £50,000 in total for the short canal cuts and the several locks required at the other three sites), on the scale of a gunboat navigation with masonry locks 20 feet by 108 feet.64 The Kempt Committee, in their June 1828 report on the Rideau Canal, recommended that the Ottawa canals be constructed with locks 33 feet by 134 feet to match the newly approved Rideau Canal locks, and in November 1828 submitted a further report, prepared by Lt. Col. Fanshawe, that it would cost £176,640 to build the Ottawa canals (the Grenville, £105,000; the Chute à Blondeau, £12,540; and the Carillon, £59,000) on the larger scale exclusive of the proposed work at the Ste. Anne's rapids.65 At this date, Lt. Col. By's scheme for constructing a navigation to the rear of Montreal in the Rivière des Prairies was under consideration, and if determined on would have eliminated the need for the Ste. Anne's lock and canal cut; but while a decision was pending, costs continued to mount of the Grenville Canal. Early in February 1829, Lt. Col. Du Vernet forwarded a progress report and estimate to Sir James Kempt in which it was reported that £113,920 had been expended on the Grenville project and £21,000 more was required to finish it in addition to £11,580 to build the Chute à Blondeau and
£58,000 for the Carillon canal respectively. This estimate in the amount of £204,000 was the first estimate submitted by the superintending engineer for building the three Ottawa canals on the scale of the Rideau navigation; and the following year, January 1830, Du Vernet submitted a revised estimate setting forth that in view of the hard compact rock encountered, it would cost £88,633.5.2½ rather than £58,000 to construct the Carillon Canal. This increase alarmed Lt. General Kempt who had immediately ordered a committee of engineers to be established under the presidency of Col. Durnford to prepare a detailed estimate for the Ottawa canals project covering every possible expenditure and contingency.

The Durnford Committee reported, 8 March 1830 that the three canals could not be completed before the fall of 1832 and would require a further expenditure of £195,242.12.10: viz. £24,131.13.3½ to finish the Grenville Canal, £20,785.5 for the Chute à Blondeau Canal, and £72,318.3.7½ for the Carillon Canal in addition to £54,243.19.2 required to enlarge the first three Grenville locks already completed on the smaller gunboat canal scale, and £23,761.11.8½ to support the canal establishment of two companies of the Royal Staff Corps which would no longer be carried on the Extraordinaries of the Army once the Ottawa canals were transferred to the Ordnance as planned on 25 June 1829. What the Durnford Committee neglected to point out however, was that to the close of 1828, £116,450.5.7 had already been expended on the Grenville Canal so that their supplementary estimate for the total cost of the three Ottawa canals was in reality in the amount of £311,692.18.5. Moreover thereafter, despite efforts to reduce the amount of difficult and expensive rock excavation by raising the summit level of the Carillon Canal and adding an extra lock and feeder, costs continued to climb and the work dragged on. The three Ottawa canals were not completed until 30 April 1834 at a final cost of £312,990, exclusive
of the building of the Ste. Anne's works and the enlargement of the three small Grenville locks, neither of which was carried out.

At their completion, the Ottawa River canals consisted of three relatively short cuttings in the bank of the river in conjunction with a 1,150 yard long feeder fed by two 9 foot high dams on an adjacent river, several piers, bridges, lockmaster's houses and the masonry locks: viz. a six mile long cut at Grenville containing three locks, 20 feet by 108 feet, and four locks 33 feet by 134 feet; and a 2½ mile long excavation at Carillon with three locks 22 feet by 134 feet. The eleven locks overcame a total difference of elevation of 60 feet; and the excavations were carried principally through solid rock of admittedly an extremely hard and compact nature, but following closely along the lie of the land. Although nowhere near as extensive as the Rideau navigation, the Ottawa canals project nonetheless required 15 years of work, was left incomplete, and incurred cost overruns, on the works actually completed, in excess of 60 per cent on the Kempt Committee's November 1828 estimate and 38 per cent over the supplementary estimate made by the superintending engineer, Lt. Col. Du Vernet.

Similarly, substantial cost overruns were incurred on many contemporary canal construction projects under the superintendence of highly competent civil engineers.

The Lachine Canal, when commenced in 1820 under the superintendence of Thomas Burnett, an English civil engineer recommended by Thomas Telford, was estimated at upwards of £78,000. By the time of its completion in the spring of 1826, £101,613.17.11 had been expended in excavating an 8½ mile long canal, two miles of which were carried through solid rock and the rest through clay and gravel, and building seven masonry locks (including a regulating or guard lock), 20 feet by 108 feet with 4½ feet of water on the sills, to overcome a difference of elevation of 44½ feet. In effect, over four work seasons, costs were
incurred which exceeded the first engineering estimate by roughly 23 per cent; and a similar development took place on the Welland Canal project.

The Welland canal, a sloop-schooner navigation on which work commenced in 1824, was estimated at £230,000 in 1827. Construction proceeded under the direction of two resident American canal engineers, Barrett and Thomas, and a consulting engineer, Nathan Roberts, each of whom together with the majority of the contractors on the Welland Canal had been employed on the construction of the Erie Canal. When difficulties developed following the collapse of the deep cut at the summit of the canal in November 1828, the Directors of the Welland Company managed to secure the services of a new superintending engineer, James Geddes, who together with Benjamin Wright a consulting engineer employed during the latter stages of the Welland Canal's construction, had been largely responsible for the planning and superintending of the Erie Canal construction project and were considered to be pre-eminent among contemporary American canal engineers. When completed in March 1833 on a 28 mile long direct line from Lake Ontario to Lake Erie with 40 wooden locks, 22 feet by 100 feet with 7 feet 6 inches of water on the sills, overcoming a difference of elevation of 310 feet, the Welland Canal had cost £356,955. This represents a 55 per cent excess over the 1827 estimate on a project which took almost 10 years to complete. Even Thomas Telford for all his canal building experience, and a recognized pre-eminence in the field matched only by that of John Rennie among contemporary civil engineers, incurred substantial cost overruns on the only British canal construction project, the Caledonian Canal, with locks on a scale comparable with the locks erected on the Rideau and Ottawa River canals.

The Caledonian Canal was commenced in 1803, and two years later when the lock size was finally determined, the work was estimated at £482,500. In 1812, with the
canal but half finished, expenditures were close to £343,500; and in 1819, the estimate was increased to £780,000. By the time the canal was opened in October 1822, £905,258 had been expended on a 58¾ mile long navigation in excavating a total of 21½ miles of canal to connect up a chain of four lakes, and building 29 masonry locks, 40 feet by 170 feet with 15 feet of water on the sills, to overcome a total difference of elevation of 193 feet. However, the canal was not completed to its full depth throughout or properly finished; and in 1838, it was estimated that a further £200,000 would be required to finish the project as originally planned. On the basis of these figures, Telford incurred a cost overrun of 87.6 percent of his first estimate for the works actually constructed over the course of a twenty year project; and if the canal had been completed as originally planned the cost overrun may well have been 129 percent or more.

Although it is difficult to compare canal construction costs, nevertheless such a rough comparison as can be made lends credence to Lt. Col. By's claim that he had constructed the Rideau navigation anywhere from 15 to 25 percent cheaper than any comparable contemporary canal construction project could have been carried out; and that he had completed in six years what in the normal course of construction would have taken 20 years. On all of the canal construction projects examined, costs were incurred far in excess of the first detailed engineering estimate, not to mention the preliminary estimate, for the respective projects (Ottawa canals, 38%; Lachine Canal, 23%; Welland Canal, 55%; and Caledonian Canal, 87.6%) and well in excess of the cost overrun (19.7 per cent) on the items in Lt. Col. By's June 1828 estimate for constructing the Rideau Canal with 33 by 134 foot locks. Even the total increase in cost of the Rideau Canal project over the June 1828 estimate, some 42.6 per cent, compares favourably with these figures as does the Rideau undertaking on a number of different
grounds. With the exception of the Lachine Canal, which was constructed in six years under relatively ideal conditions, all of the canal projects were of a duration measurable in decades: viz. 15 years on the Ottawa canals; 10 years on the Welland Canal; and 20 years on the Caledonian Canal; as opposed to the six years required to complete the Rideau project. From another viewpoint, taking into account the length and total cost of the respective canals, a rough calculation of the cost per mile again yields a comparison highly favourable to the Rideau project: viz. £6,689 per mile on the Rideau versus £11,954 on the Lachine Canal; £12,748 on the Welland Canal; £15,084 on the Caledonian Canal; and £36,752 on the Ottawa canals. (The Welland Canal locks, of course, were constructed of timber which generally cost only one-ninth as much to construct as the masonry locks erected on the other canals.82) Moreover, on the Rideau Canal Lt. Col. By had to overcome a total difference of elevation of 437 feet as opposed to 44.5 feet on the Lachine Canal, 60 feet on the Ottawa canals, 193 feet on the Caledonian Canal and 310 feet on the Welland Canal. Nonetheless, not only did By construct his canal comparatively far cheaper than the other canals under consideration; but he was forced to work under much more trying conditions, and built a far greater number of structures, almost all of which have proved to be as durable, if not more so, as any erected on the several contemporary canals.

In contrast to the other construction projects cited which were carried out close to well settled areas and/or near to well-established transportation routes, the Rideau Canal had to be constructed through a veritable wilderness and across several extensive, all but impenetrable, swamps wherein it was difficult to ascertain the level and lie of the land let alone locate suitable building stone and calculate the cost of erecting canal works at remote sites far from sources of labour and supplies. Before work could
be undertaken in the interior, Lt. Col. By had to absorb the cost of building bridges and opening up roads through the dense forest to connect up the navigable stretches of water in a country where even the few roads that did exist were at best poorly maintained wagon paths cut through the woods and, for want of any drainage, impassable for weeks, occasionally months, on end during the spring and fall. To the difficulties of transport and communication, was added the scourge of the black flies in the late spring and the mosquitoes which swarmed through the dense forest and in the swamps during the warmer weather; but even these torments paled when measured against the terrible effects of a recurrent swamp fever and ague (malaria) which struck the work sites each fall. In contrast to the Ottawa River which was free of any sickness, the Rideau waterway was extremely unhealthy. This was particularly so of the Cataraqui River section, the southern third of the canal, where the men had to work in swamps shrouded in a heavy noxious mist and excavate decayed vegetable matter which gave off a very nauseous odour. They had not only to work in the swamps, but also to sleep there and drink the bad water with the result that dysentery and sickness abounded among the work force. During the severely hot weather of the summer of 1828, these men suffered terribly from ill-health; and all the more so when fever and ague broke out in August 1828. It raged all along the canal forcing work to almost a standstill for months on end. At all of the Cataraqui locksites, the Isthmus through to Kingston Mills, the total work force fell ill bringing work to a complete halt, and the mortality rate was high. At Kingston Mills, for example, 12 out of a labour force of 100 died; at Jack's Rifts, 30 out of a force of 80 men; and at Jones' Falls two-thirds of the men died. The lake fever and ague recurrent thereafter every year about August 10th-12th and subsided about mid-September; and each year with a telling effect as the new immigrants, who were
hired to replace the deceased labourers, proved to be particularly susceptible to the disease. The sickness once caught lasted for months with the sufferer being totally incapacitated during that time.

Lt. Col. By did everything possible to provide medical care and sustenance for the sick labourers regardless of the cost, and expended a substantial amount in clearing the trees back 300 to 400 feet from each side of the locksites to ensure a free circulation of air, and in draining several swamps in the hope of eradicating the disease. These efforts to eliminate the foul air were in keeping with the prevalent medical belief of the day that malaria was caused by the bad or noxious air of the swamps; but they were of little avail. The sickness recurred and spared no one. The engineering establishment, the contractors, and overseers succumbed to it as well as the labourers; and in September 1829, even the life of Lt. Col. By was despaired of when he suffered through a severe bout of the fever which left him incapable of any exertion until the following December. Through sickness, Lt. Col. By lost not only a number of his most useful and highly skilled artificers, who were difficult to replace; but also several of the contractors whose demise forced By to add up to 600 labourers to his establishment to carry on the work. Further difficulties were experienced when as a result of its becoming known that the consequence of working on the Cataraqui section of the canal was inevitably the suffering of a severe sickness, and possibly death, workers refused to work there. To induce the workers to report to these locksites, Lt. Col. By had to resort to paying exceptionally high wages; as well as expend a great deal in building a hospital at the Isthmus, to supplement the hospital erected earlier at By Town, together with proper accommodations for the workers. In addition, he saw to it that they were well provided with as many provisions and comforts as possible to ease their lot.
sent the 7th Company of Royal Sappers and Miners to augment the large work force at the Isthmus, where anywhere from 324 to 1,316 men had been employed at one time or another on the major excavation being carried on there. Lt. Col. By was successful in inducing enough men to work on the Cataraqui to push on the work; but with the approach of the sickly season each year, from one-tenth to one-half the work force at the various locksites would leave in dread of the onset of the fever. In subsequent years, the number of deaths, if not the numbers falling sick, tended to decline. For example, of the 812 contractors' men who continued to work on the Kingston Mills to Chaffey's Mills locksites inclusive during the sickly period of August through mid-September 1830, anywhere from one-third to three quarters of the men at any one site were struck down by the fever, but only 11 men died of it in addition to 5 women and 5 children; although at the Isthmus, 27 men (as well as 13 women and 15 children) died from sickness out of a labour force of 601 men who had continued to work.99 To complete the canal, Lt. Col. By had to resort to expensive winter excavation work, sending in large numbers of men in late September of each year to push on the work as quickly as possible; and he investigated every imaginable approach by which the amount of work required might be reduced to save both lives and money. For the most part, this involved modifying the layout of the canal by adding new structures. The height of the dam and locks at Kingston Mills, for example, was increased to flood out the unhealthy swamps of the lower Cataraqui River; and likewise the lock and dam at Davis Mills were raised to reduce the amount of excavation required upstream at Chaffey's Mills; and a dam and lock were constructed at the Narrows together with a lock at the Isthmus to raise the Rideau Lake summit level four feet and reduce the amount of rock excavation required in the 1½ mile long Isthmus channel by an equal depth.100 Despite the debilitating effect of the lake or swamp fever, and being
forced to resort to carrying on excavation work during the winter in an area where temperatures could range as low as 22 degrees below zero Fahrenheit for as long as three days at a stretch,¹⁰¹ Lt. Col. By still managed to push on the work over the course of the project at what he himself regarded as an astonishing rate.¹⁰² But this was by no means his greatest achievement as on the Rideau waterway, Lt. Col. By was faced with severe floods which presented a water control and construction problem far more difficult and demanding than any faced by the canal engineers on the other projects cited.

The Rideau Canal, as distinct from most of the canals constructed during the course of the 18th and early 19th centuries, was strictly speaking not a canal at all but a canalized river.¹⁰³ For the most part, canals were constructed either by excavating an artificial channel to connect existing bodies of navigable water across a summit, or by making a cut along the bank of an unnavigable river so as to form a navigation parallel to, but independent of, the river with the latter serving as a feeder for the canal so formed. Indeed, more than one canal engineer of emminence held that it was better to construct a canal parallel to a river, and use the river only as a feeder, than to attempt to render the river navigable.¹⁰⁴ In this manner, the river was left free to run its course whether in flood or not; and the flow and volume of water entering the canal could be closely regulated. All of the canal construction projects which have been compared to the Rideau Canal herein, involved the excavation of an artificial channel and the construction of locks on dry land either parallel to a river, with the canal serving to connect up navigable stretches of a river (the Lachine and Ottawa River canals), or between two or more large bodies of navigable water (the Welland and Caledonian canals) with the rivers or lakes, respectively, serving as feeders for the canals. In contrast, the Rideau Canal as laid out by Lt. Col. By was
what was sometimes referred to as a "slackwater navigation," where dams were used to flood out the rapids of a river and back the water up from the top of one dam to the foot of another to create long stretches of still water with locks being constructed adjacent to each dam to enable boats to pass from one level to the other.\textsuperscript{105} In consequence, the canal structures had to be positioned on the river bed, and during both the course of construction and thereafter, the river had to be subdued and controlled.

During the construction of the Rideau Canal, coffer dams had to be built and maintained at every worksite both above and below the works and manual, or horse-operated pumps kept busy, in several instances all through the day and night, to enable to work to proceed and/or to keep the mortar dry until it could set properly on finished work.\textsuperscript{106} As Lt. Col. By found out to his sorrow at the Hog's Back, major works had to be pushed ahead at break-neck speed between flood seasons to ensure that they would be raised and formed sufficiently to withstand the impact of the ensuing floods without being damaged or swept away.\textsuperscript{107} Constructing a navigation under such conditions was no mean feat as both the Rideau and the Cataraqui river systems had an extensive drainage: the Rideau River draining an area of 1,550 square miles and the Cataraqui River an area of 200 square miles where the annual rainfall was roughly 30 to 35 inches with 65 to 85 inches of snow.\textsuperscript{108} Both rivers were subject to severe flash floods, which it was discovered could raise the Rideau River 14 feet above its mean level;\textsuperscript{109} and during the spring floods, the waters were choked with trees and branches thrown or toppled into the river by the settlers engaged in clearing their land as well as by heavy ice floes which, when borne on a torrent of water, were capable of severely damaging if not crushing and sweeping away dams of any description whatsoever.\textsuperscript{110} Not only did Lt. Col. By have to build substantial dams and locks capable of
withstanding the heaviest floods; but he was forced to construct major ancillary structures, far larger and more numerous than those required on canals of a more traditional configuration.\textsuperscript{111}

In addition to constructing the 47 masonry locks required to provide 437 feet of lockage and a wooden lock at By Town to serve as a dry dock, Lt. Col. By had to build 23 dams, 17 embankments and 23 waste weirs, all of which were very substantial structures.\textsuperscript{112} The cut stone locks were not only exceptionally large for their day, 33 by 134 feet with 6 feet of water on the sills, but Lt. Col. By had been forced to construct several with daringly high lifts: viz. three of the four locks at Jones Falls have a 15 foot lift.\textsuperscript{113} Among the low dams, the four of arched masonry keywork construction ranged from 200 to 481 feet in length and from 11 feet 8 inches to 18 feet high; while those constructed of timber bents, with or without extensive stone abutments, were from 5 to 10 feet high and 120 to 758 feet long. Among the high dams, the four of arched masonry keywork ranged from 176 to 350 feet long and from 18 to 62 feet high; the two rough piled stone-gravel dams were 130 and 270 feet long respectively by 16 and 18 feet high; and the four clay-earth fill dams ranged from 90 to 1616 feet long and from 3 feet 6 inches to 44 feet high. The sole timber crib dam, that at the Hog's Back, was 320 feet long and 45 feet high.\textsuperscript{114}

Constructing these dams in a wilderness was a stupendous achievement, and all the more so because the Jones Falls masonry dam of arched keywork, 62 feet high by 350 feet along the crest, was the highest dam erected in North America to that date,\textsuperscript{115} and at its commencement none of the contractors was familiar with the arched keywork construction technique required to build the dam.\textsuperscript{116} Moreover, two of the largest clay-earth dams, one 1320 feet long by 33 feet high and the other 1616 feet long by 44 feet high, had to be constructed in a swamp, Dow's Swamp, where
considerable skill, labour, and expenditure had been required to raise them on a soft bottom which tended to swallow up all the materials dumped thereon. The embankments required to keep the raised waters from pouring around the flanks of the various dams were also quite extensive. With the exception of five smaller embankments ranging from 100 to 180 feet in length and 3 feet 6 inches to 10 feet in height, they were anywhere from 241 to 2640 feet long and 7 to 14 feet high with four being well over 1500 feet long. Likewise, the 23 waste weirs constructed by Lt. Col. By were large structures in comparison with those erected on other canals. They were built of either cut stone, timber cribs, or timber bents, with single or multiple bays closed by removable stop logs from 12 to 35 feet in length. All of these structures were required to canalize the Rideau-Cataraqui river systems, and control the flooding to which the rivers were subject; and they added greatly to the cost of constructing the canal. Nonetheless, that is not to say that Lt. Col. By would have been better off to have followed the conventional system of canal construction using canal cuts to by-pass rapids rather than dams to raise the water level and flood them out.

Samuel Clowes, following his preliminary survey of the Rideau waterway undertaken in 1824-25 at the behest of the Legislature of Upper Canada, had suggested that the proposed Rideau Canal be constructed by excavating canals around the various rapids in keeping with the conventional method of canal construction. According to Clowes' canal layout, over 25 miles in total of canal cuts were required to complete the navigation; and a good deal of this excavation work would have been through solid rock as both the Rideau and Cataraqui rivers passed through bedrock plains of limestone (the Rideau) or limestone and sandstone (the Cataraqui) with only a shallow covering of soil, and the Rideau lakes headwaters were situated in the Frontenac Axis extension of the Precambrian Shield where the bedrock
was a mixture of granite and metamorphic rock overburdened with a thin layer of silt and/or clay. However, through re-locating the Ottawa River canal entrance to the Sleigh Bay-Dow's Swamp line and adopting the slackwater system of construction, Lt. Col. By managed to reduce the total length of canal cuts to 8½ miles, exclusive of the lock pit and lay-by basin excavations, and to reduce the depth to which the excavations had to be carried considerably. To cite but two examples, the raising of Rideau Lake reduced the depth of rock excavation required on the 1½ mile long Isthmus channel by some 4 feet, and the re-location of the Ottawa River entrance to the canal eliminated a total of two miles of excavation which otherwise would have had to be carried at great expense, through solid rock to a depth of from 7 to 32 feet. These were masterly strokes on the part of Lt. Col. By. Indeed, as John MacTaggart has attested, if Clowes' plan had been followed in attempting to excavate numerous canal cuts of extensive length and depth through a rocky wilderness, "it would almost have exhausted the British treasury;" or more likely, the project would have been abandoned and left incompleted after horrendous sums had been expended on it. The advantages and benefits of the slackwater method of constructing were so apparent on the Rideau Canal project that several observers, including MacTaggart, argued that canal construction by means of dams and locks, rather than the conventional locks and cuts, was ideally suited to North America. On the basis of the Rideau Canal experience, MacTaggart argued that the British method of canal construction using locks and cuts independent of rivers was not well suited to constructing navigations in the interior of the Canadas. Although in Britain the high value of land, not to mention the prejudices of canal engineers, dictated against the construction of slackwater navigations, this was not the case in the Canadas. Land prices were comparatively low, and
even if a few hundred acres of land were drowned, the loss was nothing as compared to the enhanced value of the remaining land serviced by the navigation. Moreover, often the low land to be flooded was waste land of little value or sickly swamps, the inundation of which invariably improved the health of the areas. But most importantly, the erection of dams to flood out rapids eliminated the need to carry out difficult cuttings in the wilderness, and turned the quiet stretches of water so formed into so many reservoirs for the navigation as well as providing a means of flood control for the benefit of the towns which would be established at potential mill sites along the river. A contemporary writer added that from a military point of view, a slackwater navigation such as the Rideau Canal was far superior to a conventional canal. A slackwater navigation could not be filled up, and was vulnerable to damage only at dam/lock sites; and given the impossibility of moving heavy artillery and large armies through the wilderness, a martello tower or blockhouse was judged sufficient to protect each site against marauding parties. But whatever the evident superiority of a slackwater navigation, such as Lt. Col. By chose to build, for the interior of the Canadas in terms of cost and secondary benefits, all would have been for naught had he not succeeded in constructing durable structures capable of controlling the flood waters and in devising ways of protecting these structures from the full brunt of the river when in flood. Hereby Lt. Col. By proved himself to have been not only a highly competent and conscientious engineer, but a man of some ingenuity.

Initially, Lt. Col. By had planned to construct all of the dams required to raise the water on his slackwater navigation in the form of overflow dams. In this manner, the water would have been maintained at a constant level with the surplus water flowing over the top. But in the spring of 1829, it was found that the flood waters passing
over several of the low dams constructed to that date, tore up the bed rock at the rear of the dams to such an extent that it was feared future floods might well undermine the structures themselves. To protect the dams, Lt. Col. By decided to increase their height to prevent water flowing over (with the exception of a few low dams located on relatively hard bedrock) and to construct substantial waste weirs to pass the flood waters. At the same time, he realized that the waste weirs should be so constructed as to enable the water level to be run down to facilitate the carrying out of repairs to the dams and locks. To protect the waste weirs from becoming clogged or damaged by the extraordinary amount of drift timber and the ice floes borne by the spring floods, Lt. Col. By caused floating booms to be strung across the channel upstream of each weir to catch the floating debris and enable it to be removed by men assigned to that task. On the Cataraqui section of the canal, By caused a waste weir to be built at White Falls so that the flood waters originating in the lakes which formed the headwaters of the Cataraqui River might be let off into the Gananoqui River. In the spring of 1832, the protection afforded to the canal works on the Cataraqui was augmented further following the collapse of a private dam at the outlet of Loughborough Lake. The damage caused by the surge of water passing out of Loughborough Lake into Cranberry Marsh and onwards against the works at Upper Brewer's Mills, moved Lt. Col. By to design a self-acting safety gate. This he caused to be erected across the navigation channel above Upper Brewer's so that henceforth, any surge of water passing through Cranberry Marsh would cause the gate to rise and force back the water through the marsh to the White Fish Falls waste weir and down the Gananoqui River away from the canal structures on the Cataraqui River. But the most ingenious, albeit simple, step taken to protect the canal works was a system of flood control devised in the fall of 1829, and
successfully acted upon during the three succeeding years under the direct supervision of Lt. Col. By. Under this system, the level of water in the canal was run down in November of each year and the waste weirs left open until the onset of the spring floods at which time the weirs were closed up to the navigation levels. In this manner, the full force of the floods was dissipated in filling up the lakes and long stretches of river bed and the volume of water passing down through the canal at the crest of the flood was greatly reduced. This system was so successful, it has continued to be used, in keeping with Lt. Col. By's recommendation, as the major method of flood control down to the present day.

To further protect the canal structures from flood damage, Lt. Col. By recommended that where settling occurred in the earth dams or embankments, the lock labourers should be put to work operating the two dredging, or ballast lift, machines and scows which he had left at By Town to remove the drift sand and gravel from the canal. This could be done at a trifling expense, and the material so raised was excellent fill which could be dumped where needed to take care of the settling problem. If this procedure were followed, By predicted that in time the dams and embankments would become stronger and stronger as they became more consolidated and their slopes were extended at a lower angle. Lastly, Lt. Col. By recommended that the lock labourers at the various lockstations should be employed in their spare time to aid the artificers, who circulated from station to station, in pointing and grouting the masonry works where required with hydraulic cement as part of an ongoing effort to protect them from the elements.

Both of these procedures were inaugurated on the Rideau Canal and were carried out during the course of the 19th century and well into the 20th century, with results that are a tribute to Lt. Col. By's ingenuity in devising effective methods of flood control and economical
maintenance procedures, as well as a testament to the quality of design and workmanship embodied in those structures.

Although the gradual clearing off of the heavy forest cover, which formerly retarded the melting of the winter accumulation of snow in the Rideau corridor, resulted in increasingly heavy, and sudden, spring run offs that taxed the flood control system and placed a severe strain on the canal works, only a small number of relatively minor failures have occurred. During the long period of commercial activity on the Rideau Canal from its opening through to the First World War, major floods struck with ever increasing intensity in 1836, 1841, 1847, 1858, 1862, 1908 and 1909. On each occasion, drift wood and ice floes borne on the crest of the flood broke through some of the protecting booms and breached several of the waste weirs and low overflow dams; but none of the high stone arched dams were ever damaged, and only one of the lesser structures suffered repeated injury: viz. the waste weir at Long Island. That structure, which was swept away in 1836, and again in 1847 and 1858, was poorly sited on a clay foundation and had to be re-located in the latter year. The other waste weirs and low overflow dams suffered only random, readily repairable, injury; and a large number of the original structures were not replaced until well into the 20th century when they were generally renewed in concrete. Most of the 47 masonry locks, but not the wood dry-dock lock, constructed by Lt. Col. By have continued to function to the present day with but minor repairs, or in several instances a partial rebuilding and renewal of the stonework. Throughout the 19th century, and during the first two decades of the 20th, the stonework was replaced in kind where it had badly deteriorated; but after 1922 repairs were carried out, in the several instances where they were required, through replacing the stone with concrete blocks of the same
The wooden lock gates have had to be replaced on an average of once every fifteen to twenty years. Indeed, only one lock constructed by Lt. Col. By proved difficult to maintain in operation: viz. the Lower Brewer's lock, which owing to the prevalence of the fever and ague at the site, was hurriedly erected on an unstable foundation. This lock leaked badly through the masonry as early as 1840, and had to be kept under constant repair, and continually grouted, to remain operational. The east wall of the lock had to be taken down and rebuilt in 1861, the west wall in 1874, and the west wall again in 1905-06. Finally, in 1976, the masonry lock had to be removed, and was replaced with a concrete box faced with stone from the old lock to maintain its original appearance.

The high dams have survived to the present day unscathed, and a goodly number have been strengthened considerably over the years through the practice, recommended by Lt. Col. By, of dumping silt and gravel from the bed of the canal against these structures. This has been so successful that a number of the original dams now appear to be but a part of the natural landscape. In sum, with the exception of the lock at Lower Brewer's [Washburn] and the Long Island waste weir, both of which were badly sited on poor foundations, and the waste weirs and low overflow dams which enjoyed an extended life span before being replaced, the numerous canal structures erected by Lt. Col. By have proved to be amazingly durable. Moreover, major expenditures were not required to keep them in repair as was the case with the structures built on several contemporary canals.

Of the four contemporary canals compared previously to the Rideau Canal in terms of their construction costs and the duration of the respective projects, two required costly repairs in the years immediately following their completion. The Lachine and the Ottawa canals were well built, and very
little was expended on maintenance in the decade following their construction or probably thereafter. Likewise, the Rideau Canal, which was widely acclaimed by all who viewed it as one of the finest canals ever constructed, required few repairs. Almost a decade after its construction, the Rideau Canal was costing only £9,270 per year to maintain and operate including the support of the canal establishment; but exclusive of flood damages which in one of the worst years, that of the great flood of 1847, required only an estimated £2,277.3.1½ to repair. In contrast, heavy expenditures had to be made on both the Welland and Caledonian canals soon after their completion. As of its opening in March 1833, the Welland Canal cost £356,955; but by the close of the year 1837, a further £94,574 had been expended in making extensive repairs and the wooden locks were decaying so rapidly that plans had to be made for reconstructing the canal. Thereafter, the high cost of repairs threatened to force the abandonment of the canal until 1843 when the government of the Canadas purchased the navigation and appropriated £450,000 for its reconstruction with masonry locks designed to pass the screw steamers then plying the Great Lakes: viz. locks 150 by 26½ feet with 8½ feet of water on the sills. In effect, the failure to build durable structures necessitated heavy expenditures on maintenance, and forced the closing of the canal for extended periods of time while repairs were being carried out; and this failure, coupled with a lack of foresight in constructing locks insufficiently large to pass steamboats, ultimately necessitated a total reconstruction of the canal on a larger scale with more durable structures at a cost in excess of the outlay on the original canal. Heavy maintenance expenditures were also incurred on the Caledonian Canal, but for a different reason. That canal, on which £905,258 had been expended as of its opening in 1822, was constructed with masonry locks;
but poor workmanship resulted in structural failures which by 1843 it was estimated would cost upwards of £136,089 to repair.\textsuperscript{150}

However viewed, it is clear that Lt. Col. By succeeded in constructing on the Rideau navigation canal works which were second to none in durability even though built under extremely trying conditions and subjected to water pressures far in excess of that inflicted on more conventional canals.\textsuperscript{151} What was accomplished was a credit to By's capabilities as an engineer in designing permanent structures and his originality in devising a canal layout that could be constructed at a reasonable cost; but it was equally a measure of his inordinate capacity to organize and supervise a work of the magnitude of the Rideau Canal project where for the better part of six years uniform standards of construction had to be enforced and direction given to a work force of upwards of 4,000 men\textsuperscript{152} scattered over more than two dozen work sites along a waterway winding through 123 miles of extensive swamps and wilderness. In retrospect, it is surprising that Lt. Col. By was able even to complete the building of the Rideau Canal in the face of the seemingly overwhelming difficulties that he encountered; and that he did so in six years for the sum of £822,804 is scarcely believable given the cost and duration of major contemporary engineering projects of a much less demanding and difficult nature.

In view of the evidence furnished by the comparisons developed herein, it is reasonably certain that had the Treasury Board in 1832, or Lt. Col. By's latter day critics for that matter, taken the time to undertake even a cursory examination of comparative canal building costs and made themselves aware of the peculiar difficulties under which the Rideau Canal was constructed, they would never have questioned By's competence in the role of a superintending engineer. He had indeed succeeded in constructing a magnificent steamboat navigation at a cost significantly
lower, taking into consideration the scale of construction, than any comparable canal in the Canadas, and possibly Great Britain as well; and he had accomplished this in a remarkably short period of time. But unfortunately for Lt. Col. By, his critics were concerned only with the magnitude of the sum, the £822,804, expended on the Rideau Canal and, in the absence of any effort to assess whether the money was well spent, assumed the contrary. Indeed, had Treasury Board even paused to compare Lt. Col. By's expenditures and cost overruns over the Rideau estimates with those on other Ordnance construction projects, they would have viewed Lt. Col. By's efforts in a very different light.
Ordnance Construction Projects and the Defeat of Wellington's Grand Strategy

Out of all the various fortresses and inland canals that the Duke of Wellington had recommended be built in his March 1819 plan of defence, and for most of which Major General Carmichael Smyth provided preliminary cost estimates in his September 1825 report, only the citadels of Quebec and Halifax, and the fortifications at Isle aux Noix and Kingston, were actually undertaken together with the Ottawa River and Rideau canals. These projects do, however, furnish a useful basis of comparison for assessing Lt. Col. By's engineering performance insofar as construction costs and estimates, and the amount of work accomplished in a given period of time, are concerned; and the course of developments concerning these projects does yield sufficient information to assess whether or not it was the large Rideau Canal expenditures that were directly responsible for the subsequent drastic curtailment of the projected Ordnance scheme of construction and the consequent failure to implement Wellington's defence strategy. More generally, the later efforts of the Ordnance to develop a viable system of defence for Upper Canada, incorporating the several permanent structures that were completed in keeping with the Smyth Commission recommendations, provide further evidence that the military arguments used by Lt. Col. By to convince the Ordnance to construct the Rideau Canal, and subsequently the Ottawa River canals, as a steamboat navigation rather than a gunboat canal were essentially valid. Within a decade of the June 1828 decision to construct the Rideau Canal with locks sufficiently large to accommodate
steamboats, it was evident to the Ordnance and the Admiralty that steamboats, rather than sail/oar propelled gunboats, were the military transport vessels of the future; and, from a military point of view, little doubt remained as to whether the extra cost entailed in constructing the Rideau Canal with the larger 33 by 134 foot steamboat locks was justified or not.

**Inadequate Estimates and Unpalatable Costs**

The first two fortifications projects to be undertaken in the programme of construction initiated by the Ordnance for the realization of Wellington's grand strategy, were Fort Lennox on Isle aux Noix and the Quebec citadel. Where initially the military authorities had planned to expend roughly £10,000 to strengthen the palisaded earthworks of the existing fort on Isle aux Noix dating from the American Revolutionary war, by 1819 it was decided in keeping with Wellington's scheme to construct a totally new fortification at an estimated cost of £86,726. Work commenced in May 1819, and by 1825, £57,000 had been expended on building what was basically a small bastioned fort of masonry construction, 300 yards square, with escarps 18 feet high and counterscarps 12 feet high containing a ditch of 6 foot depth of water.\(^2\) When Major General Carmichael Smyth visited Isle aux Noix in that year, the fort was two-thirds finished and proceeding in keeping with the £86,726 estimate.\(^3\) Whether or not the final cost exceeded that amount is not known, but the fort was not finished until 1829 by which time repairs were already required. Soil conditions on the island proved so unstable that in 1828 the slope of the ravelin began to slip away, and in 1831, most of the curtains and bastions were seriously eroded. In 1842-43, Royal Engineers had to be sent out to reconstruct the escarps on the south and east, and half of the north curtains and bastions; and the erosion problem continued to be so serious that by 1845 the fort was considered
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untenable. Although no figures have been found for the final cost of Fort Lennox, it is nonetheless evident that if there were not serious cost overruns in the actual construction of the fort, as one would suspect there were in view of the numerous construction problems that plagued the project, large expenditures were required to keep it in repair thereafter. Moreover, it was to take 10 years to complete the fort exclusive of the repairs which were required. The Quebec citadel, on the other hand, was apparently well constructed; but when work commenced in May 1820, the project was estimated at £70,000. By 1825, with the work only one-third completed, £60,374 had been expended and Col. Durnford, the Commanding Royal Engineer for Canada, estimated an additional £150,000 would be required to complete it. The final cost of the citadel on completion in 1831 was £236,540, an excess of 12.4 percent of the supplementary estimate of 1825, and of 238 percent on the initial engineering estimate. Moreover, the initial engineering estimate for the Quebec citadel project was based on plans prepared on the spot by Col. Durnford in 1819. Clearly, a substantial cost overrun was being experienced on one of the two permanent fortifications projects on which construction had commenced prior to the submission of Smyth’s report of September 1825, and costly repairs were soon to be required on the other; and this factor, in conjunction with the huge projected cost of completing the North American defence system in keeping with Smyth’s recommendations, some £1,686,944, did not augur well for its acceptance by Parliament then or thereafter. Indeed, the difficulties experienced by the Ordnance in attempting to secure Treasury Board approval for the Kingston estimates, and subsequently Parliamentary support for the expenditures required to construct but a small number of the works recommended by the Smyth Commission, show that there were definite limits to the amount of spending Parliament would authorize for colonial defence projects.
Kingston, as mentioned, was regarded by post-War of 1812 military strategists as being the key to the defence of Upper Canada. It sat astride the existing St. Lawrence River communication and supply route from Lower Canada as well as the southern entrance of the projected Rideau Canal; and, in addition, to being the supply depot for the upper province, it was the headquarters of the naval establishment for Lake Ontario and the location of the dockyard where warships were constructed for service on that strategic waterway. If Kingston were to fall, it would entail the loss of Upper Canada as well as enable American forces to descend the St. Lawrence in aid of any invasion force moving on Montreal by way of the Lake Champlain route. 7 Although Wellington's strategy of constructing a number of interior canals to interconnect with strong permanent fortifications strategically located to block potential American invasion routes, if carried out, would have supposedly eliminated the need in the event of war to engage in a critical shipbuilding race with the Americans for control of Lake Ontario, 8 he by no means intended the naval establishment or the dockyard at Kingston should be closed down. Even though no effort was to be made to engage in naval warfare for supremacy on the Great Lakes, and no large scale offensive operations were to be launched against the United States from the Canadas, under Wellington's defence plan the dockyard was still required to construct the warships needed to protect the open water approaches to Kingston, York and the Niagara frontier, and a small naval establishment at Kingston was likewise essential to maintain the naval stores which would be used to equip the gunboat flotillas intended for transport duties. 9

At the time of Major General Carmichael Smyth's tour of inspection in 1825, Kingston harbour was defended by a sea battery at either side, on Point Missassaga and on Point Frederick respectively; and the dockyard, just to the east of the harbour on Navy Bay, was protected by the Point
Frederick sea battery and a wooden fort on Point Henry. These structures, however, were in a bad state of repair; and Carmichael Smyth in his report recommended that the fort be reconstructed in masonry with an escarp thirty feet high and a counterscarp; that the sea batteries be enclosed in the rear; and that three towers be constructed at specified points on the perimeter of the dockyard area; viz. on the mainland to the north of Fort Henry, on Cedar Island off shore from Point Henry, and on Snake Island near the main shipping channel. If this were done, Smyth believed it would render the dockyard and harbour, as well as the southern entrance of the proposed Rideau Canal, secure at an estimated cost of £201,718.¹⁰

To carry out the Smyth Commission recommendations, Lt. Col. Wright, R.E., was dispatched from London in the spring of 1826 under orders to quarry stone and prepare a detailed plan and estimate for the proposed Kingston fortifications. However, in contrast to the instructions given to Lt. Col. By, who received a simultaneous appointment to construct the Rideau Canal, Lt. Col. Wright was instructed to confine his expenditures to £5,000, and not to proceed with the actual construction of the fortifications until notified that his plan and estimate, once completed, had been submitted to Parliament and approved. In the event the required expenditures were not approved, then Lt. Col. Wright was to use the quarried stone to make repairs to the existing structures.¹¹ The first set of plans and an estimate were submitted by Lt. Col. Wright as early as February 1827 in keeping with the Smyth Commission recommendations; but at the same time, Lt. Col. Wright recommended that two additional stone masonry towers be built in advance of Point Frederick to render the dockyard more secure. The Ordnance, over the objections of Major General Smyth, agreed to the need for the two additional works; and in October 1827, Lt. Col. Wright submitted a cost estimate of £219,649 for the revised Kingston project, some £18,000 more than the Smyth
Commission preliminary estimate. This estimate the Ordnance prepared to submit to Parliament in the spring of 1828; but the submission had to be made in circumstances that placed not only the Kingston fortifications project but the whole scheme of works required to implement the Duke of Wellington's defence strategy in jeopardy.

Although Lt. Col. Wright's estimate was not appreciably higher than the preliminary estimate for the Kingston project, that was decidedly not the case where the other Ordnance defense projects were concerned. During the winter of 1827-28, the reports of the Officers of the Royal Engineers dispatched to prepare plans and estimates for the construction of the major works recommended in the Smyth Commission report of 1825, began to arrive at the Ordnance; and Lt. Col. By's report, that the Rideau Canal would cost far more than anticipated by the Ordnance (£474,844 for the twenty foot wide lock rather than the £169,000 preliminary estimate), was far from singular. With but few exceptions, all of the engineering estimates exceeded the preliminary estimate formed by the Smyth Commission, and some were far in excess. To cite but a few examples, the estimate for the Montreal citadel had increased from £250,000 to £315,122; the works on St. Helen's Island from £42,500 to £52,311; Fort Henry, of course, from £201,718 to £219,649; the Niagara, or Short Hills, fortress from £250,000 to £288,746; the fortified barracks to be constructed at Chatham from £50,000 to £117,593; and so forth. The only major work to come in under the preliminary estimate was the Halifax citadel at a projected cost of £115,998 as opposed to the initial estimate of £160,000 (and the cost of that project as it developed was grossly underestimated by the commanding engineer Col. Nicolls). In effect, the total expenditure required to complete the Rideau and Ottawa canals and undertake the major new works required to complete Wellington's scheme of defence rose from a total of £1,686,944 to £2,335,544 or more. Clearly something
had to be done as the Ordnance was well aware that Parliament would never approve of such a sum being expended on a colonial defence project.

Despite the promptings of the Ordnance, successive British governments had proved loath to submit Wellington's defence scheme to Parliament for approval. When the Smyth Report arrived at the Ordnance in December 1825, it was forwarded to the government by the Master General, the Duke of Wellington. But the government of the day, no less than Wellington himself, realized that Parliament would not look favourably on the enormous expenditures required to realize the project. To get around that difficulty, Wellington suggested that perhaps a secret Committee of the House of Commons might be formed to approve the project, and recommended that £100,000 should be required of Parliament in 1826 to get work underway.14 The government of Lord Liverpool, however, decided to postpone consideration of the project until the engineering estimates were received, and successive government administrations: that of Canning (April - August 1827) and that of Viscount Goderich (August 1827 - January 1828), proved equally unwilling to broach Parliament on the subject. Limited sums continued to be voted for carrying on the earlier works already approved and underway: viz. the fort at Isle aux Noix, the citadel at Quebec, and monies were expended on the Grenville Canal; but only one of the new works recommended in Smyth's report received any appropriation: viz. the Rideau Canal, for which the sum of £5,000 had been requested in the 1826 Ordnance Estimates passed by Parliament.15 Preliminary survey and levelling work, of course, had been undertaken in that year on the Kingston project; but no monies were voted for construction to proceed. According to standing government regulations, local military commanders could draw on the military chest to carry out repairs to fortifications or erect temporary fieldworks, but had to have the authorization of the Board of Ordnance, and parliamentary
approval, before commencing the construction of permanent military works. On the Kingston project, of course, Lt. Col. Wright was acting on orders from the Ordnance; and it was made clear in his 1826 instructions that he was not to commence building the permanent fortifications until Parliamentary approval had been obtained for the plans and estimate that he was to prepare. But where the canal communications projects were concerned, the Ordnance had proceeded with construction work, as in the case of the Grenville Canal in 1819 and the Rideau Canal in 1826, before plans and an estimate were prepared for submission to Parliament for approval; and, in the case of the Grenville Canal, this had been done in a rather unorthodox manner.

On 13 August 1819, prior to the government of Lower Canada undertaking work on the Lachine Canal, the Treasury Board had authorized the Duke of Richmond, the Governor-in-Chief of the Canadas and Commander of the Forces, to pay out of the Army Extraordinaries one half of the cost of constructing the projected canal which a preliminary survey had indicated would cost upwards of £50,000 if constructed as a batteaux navigation. However, the Duke of Richmond invested only £15,000 in the Lachine Canal project (by taking out 300 shares at £50 each) in return for a guarantee of free passage through the canal for all government vessels. The main objective of the British government being thereby secured, Richmond then, on his own initiative, ordered a detachment of the Royal Staff Corps to commence the construction of a canal at Grenville on the Ottawa River, and appropriated the remaining £10,000 of the authorized expenditure to that project. At that time, the preliminary estimate for constructing a batteaux canal at Grenville and improving the passage through the rapids of the Chute à Blondeau and Carillon was £16,740. Thereafter, work had continued on the Grenville Canal through to the close of the year 1823 by which time upwards of £25,000 had been expended.
limiting the monies to be expended in any given year, beyond
the initial £10,000 appropriation, to less than £8,000 so
that the cost could be borne on the Army Extraordinaries
where, according to the existing regulations, expenditures
below that sum did not have to be itemized and identified
for Parliamentary approval. Hence Treasury Board was
not informed of these expenditures until December 1823 when
Lord Dalhousie, then Governor General and Commander of the
Forces, requested Treasury Board approval for the
expenditure of £8,000 per year for three years to complete
the Grenville Canal on a larger scale than originally
contemplated: viz. on the Lachine Canal scale with gunboat
locks 20 feet by 108 feet with 4½ feet of water on the
sills. Treasury Board had agreed to the new estimate of
£49,000 and authorized the requested expenditure on the
assurance that it would suffice to bring about the
completion of the Grenville Canal by the fall of 1826.

Thereafter, in September 1825 Major General Carmichael Smyth
reported to the Ordnance, as mentioned, that the Grenville
Canal would cost £60,000 to construct of which £32,000 had
been expended to that date; and that a further £50,000 would
be required to construct short canals required at the Chute
à Blondeau, Carillon and Ste. Anne's rapids to complete the
Ottawa navigation. This revised, and heavily
augmented estimate, however, was not to be submitted to the
Lords of the Treasury and placed before Parliament until the
spring of 1828. In effect, neither Treasury Board nor
Parliament had authorized the commencement of construction
work on the Grenville Canal; and no monies had been
appropriated to that project by Parliament prior to 1828
although Treasury Board had authorized major expenditures
from the Army Extraordinaries in 1823. A somewhat similar,
although less irregular, development had taken place on the
Rideau where construction had commenced in 1826 without the
prior approval of Parliament.
In 1826, parliamentary approval was sought for an appropriation of £5,000 for the Rideau Canal project; and this was voted on the assumption that it would be used to prepare plans and an estimate for submission to Parliament prior to the actual work being undertaken.23 Unbeknownst to Parliament, however, the Ordnance authorized work to proceed on the actual construction of the canal while the plans and estimate were being prepared; and construction did proceed in that year. Parliamentary approval for the construction of the canal was not obtained until 1827 when it was secured on the basis of the £169,000 preliminary estimate, and £41,000 was voted to cover construction expenditures on the project for that year (£169,000 less £5,000 with the remainder averaged over the remaining four years of the project).

Although the Ottawa Canals and Rideau projects had been commenced in such a way as to effectively deprive Parliament of its control over the initiation of construction projects entailing major expenditures of public monies, the Ordnance was scrupulously correct in its actions where fortifications projects had been undertaken or were about to be undertaken. Hence work did not commence on any of the new fortifications projects pending the approval of Parliament; but, as related, successive governments had refused to bring additional fortifications projects before Parliament which remained ignorant of the Ordnance's North American defence scheme and the enormous sums that would be required to carry it out.24 However, in January 1828, Wellington formed his own administration; and thereafter, as Prime Minister and First Lord of the Treasury, he was in a position to insist that his scheme be submitted to Parliament.25 But first, something had to be done to reduce the projected cost of the defence project which the engineering estimates, received during the winter of 1827-28, had swelled considerably.
To render the projected costs of the North American defence scheme more palatable to Parliament and thereby increase the probability of securing Parliamentary support, the Ordnance separated the canal construction work from the fortifications projects and divided the latter into three stages: viz. important works, absolutely and urgently necessary for the defence of North America; less important works, desirable at some future period; and lesser works, that would not be required for a number of years.

Parliament was informed, in the spring of 1828, that works of the second and third class were to be postponed indefinitely; but that immediate approval was required for construction to commence on the works of the first class. Included in the latter category were: the Kingston fortifications at an estimated cost of £214,649; the Montreal defences at Saint Jean on the Richelieu River (£48,187), Chateauguay (£43,083), Saint Helen's Island (£52,311), and Montreal (the citadel at £315,122); and the Halifax defence complex, including Needham Hill (£8,865) and the citadel (£124,863). This made for a total estimated cost of £798,215, exclusive of contingencies and changes in detail. In round numbers, it was suggested that £900,000 would be required to construct the works in the first class; and that they could be completed in six years at an estimated outlay of £150,000 per year. (Expenditures, of course, were still being made on the Fort Lennox and the Quebec citadel projects which were not completed until 1829 and 1831 respectively; but these works had been authorized at an earlier date.) With respect to the canals, £15,000 was requested to carry on the Ottawa canals project in 1828; and Parliamentary approval was sought for a revised Rideau Canal project estimate.

The members were informed that the preliminary Rideau Canal estimate of £169,000, submitted to Parliament and approved in 1827, was insufficient for the work; and, that although the superintending engineer, Lt. Col. By, had
reported this to be the case in 1826, his report had not been received until after the 1827 parliamentary vote was taken. When the engineering estimate arrived, late in 1827, it revealed that the sum required to construct the canal with locks 20 by 108 feet was £474,844. But Lt. Col. By had enclosed comments on the advantages to be gained if the locks were constructed on a scale of 50 by 150 feet; and these advantages had so impressed the engineers of the Ordnance that a committee (the Kempt Committee) was being sent to Canada to evaluate the proposal on the spot. If the enlargement were approved, it would raise the Rideau estimate to £527,844. To bring the members up to date with developments on the Rideau Canal project, they were informed further that Lt. Col. By in carrying out his instructions "to carry on as rapidly as he could" had expended monies in excess of the sums voted to the end of 1827. Consequently, in January 1828, a stop work order had been issued; but since contracts were already in force which would involve the government in losses if the project were aborted, it was recommended that the Rideau project should be carried on and a sum voted in 1828 sufficient to cover both the deficiency and By's projected disbursements in the present year. If Parliament were to approve of the additional sums required, Lt. Col. By had given his assurances that the canal would be completed in 1830 or 1831 at the latest.27

Once the total cost of the Ordnance projects required to carry out Wellington's scheme of defence for North America became known, the worst fears of its proponents were realized. Parliament appropriated the funds required in 1828 to cover projected expenditures on the projects already underway (the Ottawa canals, Fort Lennox, and the Quebec citadel) and voted the £120,000 that the Ordnance declared would be required to balance Lt. Col. By's receipts and expenditures on the Rideau project to the close of 1828;28 but the new works that the Ordnance wished to undertake in keeping with the class one designation, were
totally rejected. In an effort to salvage several of the proposed new works, the Ordnance worked out a compromise proposal; and on 3 July 1828, submitted a supplementary estimate in which it was requested that the Kingston and Halifax defence projects be approved at a combined estimate of £330,664, with £30,000 to be voted toward their construction in 1828. An acrimonious debate ensued during which prominent Reformers, and even Huskisson, a Canningite who had but recently been a member of the Wellington administration, expressed their opposition to the very principle of expending money on colonial defence projects. Colonies were declared to be of little commercial value; and all expenditures thereon were considered a waste as colonies in the natural order of things were expected to eventually separate from the mother country and pursue an independent course.29 After a prolonged debate, the compromise proposal was finally accepted; and the two new projects approved at an estimated cost in keeping with their combined engineering estimates as pared down slightly by the engineers at the Ordnance. At this point it was evident, if indeed it was not from the very inception of Wellington's defence scheme, that Parliament would never vote the huge sums of money required to carry it to a completion. Moreover, the attitude expressed by the Reformers in debate made it clear that should they come to power, as they eventually did in November 1830, further large scale expenditures on colonial military projects would be opposed if not severely censured.

Although the Ordnance, in the face of strong Parliamentary opposition, did manage to secure approval for the construction of two new works: the Halifax citadel and the Kingston fortifications; it was not possible to commence work immediately on the latter. To arrive at the £330,664 combined estimate for the Halifax-Kingston projects that was presented to Parliament in the July 1828 compromise proposal, the Ordnance apparently accepted the £115,998
engineering estimate for the Halifax citadel, but reduced the Kingston fortifications engineering estimate to £186,087, and then added 10 per cent to the combined figure to cover contingencies. In effect, the Kingston estimate of Lt. Col. Wright was reduced by almost one-sixth to a figure slightly below Smyth's preliminary estimate for the project. Steps had to be taken therefore to reduce the projected cost of the Kingston fortifications project in keeping with the revised estimate prepared for Parliament. Consequently, when the Kempt Committee assembled in Canada in June 1828 to examine Lt. Col. By's plans and estimate and to determine the size of lock to be constructed on the Rideau Canal, two of its members, Lieutenant Colonels Fanshawe and Lewis, were under orders to proceed thereafter to Kingston to examine Lt. Col. Wright's plans on the spot and make revisions in keeping with the revised estimate of £186,087.30

Far from recommending a reduction in the proposed fortifications system, Fanshawe and Lewis concluded that the proposed works were inadequate to protect either the naval dockyard or the comissariat stores on Point Henry from a coup de main or a bombardment from the other side of the harbour; and they ordered a survey and levels to be taken to prove their point.31 This, of course, was precisely the conclusion that Lt. Col. By had reached in November-December 1827 when he had recommended that the naval arsenal, stores depot, and the dockyard, be transferred to the Ottawa River at By Town where warships could be constructed in complete security and then towed down to Lake Ontario through his proposed large lock (150 feet by 50 feet with 10 feet, or as a compromise 5 feet, of water on the sills) steamboat navigation.32 However, the Kempt Committee decision of June 1828 in favour of constructing locks 134 feet by 33 feet with 5 feet of water on the sills, effectively eliminated the alternative of transferring the dockyard (but not the proposed transfer of the Ordnance stores) to the Ottawa River;33 and in their July 1828 report on the
proposed Kingston defences, Fanshawe and Lewis tackled the problem of providing an adequate defence for the dockyard and Ordnance stores. They recommended that Lt. Col. Wright's plans, based on Smyth's original scheme of defence, should be scrapped in favour of a circle of casemated redoubts around the perimeter of the Kingston harbour-naval dockyard area at an estimated cost of £206,413, exclusive of the expenditures required for the gun platforms.34 Although this represented a saving on the projected cost of the original system of defence, the saving was not sufficient to bring the estimate within the sum that Parliament, almost simultaneously, was voting to accept for the project. Moreover, the Ordnance now had two different plans and estimates for the defense of Kingston.

In September 1829, a committee of Royal Engineers under the presidency of Major General Sir Alexander Bryce, who had presided over the committee in London that had investigated Lt. Col. By's plans and estimate in January 1828, was established by the Ordnance to examine into the conflicting proposals for the defence of Kingston. This second Bryce Committee reported, 24 October 1829, that the ground on Point Henry in their estimation was of too confined a nature for the extensive bastioned fort recommended by the Smyth Commission, and that the excavations required for the ditches and for defilading the work would have to be carried out in solid rock at an enormous expense. (A suggestion that the preliminary estimate of the Smyth Commission for the project was woefully inadequate for the works proposed should they be undertaken.) The Bryce Committee therefore recommended that a large casemated redoubt with reverse fire be constructed on Point Henry at an estimated cost of one-third the bastioned fort, together with a series of five similar works on a somewhat smaller scale to be situated in keeping with the system of defence outlined by Fanshawe and Lewis in their July 1828 report.35
To protect the naval dockyard and the Commissariat stores on Point Henry from attack or bombardment at a distance, the Bryce Committee recommended that the ring of six large redoubts should be constructed, with high reveted scarps and deep counter scarps and casemates for a reverse fire to flank the ditches, on the land perimeter enclosing the town of Kingston to the west of the Harbour-Rideau Canal entrance, and the naval dockyard and commissariat stores to the east of the harbour. Each redoubt was to be garrisoned with from 150 to 220 men, with the exception of the largest, Fort Henry, which was to have a garrison of 350 men. The eastern approach was to be defended by an arch of three redoubts, including Fort Henry, supported on the landward perimeter by three Martello Towers, and defended to seaward by an advanced sea battery to the rear of the Henry redoubt and the existing sea battery on Point Frederick. Two flank ditches were also to be constructed from the edge of the ditch of Fort Henry to the water on either side of Point Henry to form an enclosed area to protect the existing Ordnance stores, and any future Commissariat buildings to be constructed. The western side of Kingston harbour was to be defended on the landward approach by three casemated redoubts on an arc around the outer perimeter of the town, with a tower and sea battery at Murney's Point and a tower on Snake Island to guard the sea approach. In addition to the construction of these works, it was recommended that a battery be constructed at Tête de Point on the west side of the inner harbour to defend the low ground on the right flank of the arc of redoubts. In total, the Bryce Committee recommended the construction of six casemated redoubts, six Martello towers, and three new batteries, in addition to the repair and enclosure of the existing sea battery on Point Frederick. It was estimated that the sixteen works recommended would cost £273,000, exclusive of the purchase of the required land, which on the west side of the harbour was in private hands.
This elaborate and costly system of defence, it should be noted, was put forward not by the man on the spot, Lt. Col. Wright who had submitted plans and an estimate in keeping with the works that he was instructed to make preparations to construct, but, rather was formulated by a committee of senior officers of the Ordnance in London, who were well aware that the projected cost was far in excess of the estimate accepted by Parliament in the previous year. What is more, the new plan and estimate were subsequently approved by the Master General and Board of Ordnance; and when Treasury Board refused to consider any increase in the 1828 estimate for the project, a stalemate ensued. The Ordnance remained adamant that the 1825 plan, which the 1828 compromise estimate was intended to cover, was inadequate to defend the dockyard. Finally, Sir James Kempt, who had succeeded Lord Beresford as Master General of the Ordnance in 1830, submitted a second compromise proposal which Treasury Board and the Colonial Department in January 1832 agreed to accept so that the Kingston project could go forward. By the terms of this agreement, two redoubts and one sea battery were to be eliminated from the 1829 plan to reduce its projected cost to £220,000, which represented only a £33,913 increase over the 1828 estimate accepted previously by Parliament; and the works were to be constructed one at a time, starting with the Fort Henry redoubt, on separate estimates to be approved by Parliament as required for construction work to continue.

To this point, expenditures on the Rideau Canal had little impact on whether or not Parliament accepted the defence projects recommended by the Ordnance for North America or at least no more so than the escalating estimates for the fortifications projects presented to Parliament under the Class One designation for immediate construction. The supplementary estimate of £693,449, necessitated because of the newly discovered need to construct waste weirs and cover a minor cost overrun that had been incurred on the
June 1828 estimate, had been accepted by Parliament in 1830; and so far as Treasury Board and Parliament were aware, the Rideau Canal expenditures were still within the supplementary estimate. Interestingly enough, the Ordnance had received a report from Lt. Col. By in September which indicated for the first time that the supplementary estimate would be exceeded (by at least £25,624.13.4); but that report was not forwarded to Treasury Board until 3 February 1832. The Ordnance, in effect, delayed five months before forwarding the Rideau Canal report on projected expenditures to the Treasury Board; and during that period, the compromise was worked out that enabled work to commence on the Fort Henry redoubt in keeping with the truncated plan of 1829. The report that aroused Treasury Board to question By's competence and demand his recall (viz. the December 1831 progress report stating that the canal would not be completed until 1832, and would probably cost upwards of £776,024, or some £83,358 more than the supplementary estimate figure accepted by Parliament), did not arrive in London until May 1832 at which time it was immediately forwarded to the Treasury. That report, as related previously, did raise the ire of the Treasury Board against Lt. Col. By, the Ordnance, and colonial defence expenditures in general; but by that time, the programme of construction proposed by the Ordnance to carry out Wellington's plan of defence had been compromised almost out of existence in a futile effort to obtain parliamentary approval for the more critical works. The compromise, reached with Parliament in July 1828, provided that work would proceed on only two new works: the Kingston fortifications and the Halifax citadel; and the temper of Parliament was such that, even with a tory administration in power headed by the Duke of Wellington, efforts to obtain approval for additional works would have been doomed to failure had they been made. The immediate impact of the Rideau Canal project cost overrun was felt only in the
refusal of the Treasury Board to countenance the voting of any monies for the enlargement of the three Grenville locks which were built on the small 20 by 108 foot scale prior to the decision to construct the locks of the Ottawa River canals on the scale of the Rideau Canal locks: viz. 33 feet by 134 feet; and the subsequent shelving of the projected Rivière des Prairies canal to the rear of Montreal and its proposed alternate, the short canal and lock at Ste. Anne's. (The latter had to be constructed by a private company, The Ottawa Forwarding Company, which built a wooden lock at Vaudreuil opposite Ste-Anne's in 1832-33 to complete the Ottawa River canals system.) Otherwise, Parliament continued to vote the funds required to cover the expenditures made on the Rideau Canal until its completion in August 1832; as well as the sums required for the completion of the Chute à Blondeau and Carillon canals on the Ottawa River and the Halifax citadel project on which construction was proceeding. The hostile reaction of the Treasury Board to the cost overrun on the Rideau Canal project, however, may have been a contributing factor in what transpired thereafter at Kingston.

Once the compromise proposal of January 1832 was accepted, orders were issued to Lt. Col. Wright to proceed with the construction of the Fort Henry redoubt and an advanced sea battery to its rear at an estimated cost of £70,000. Work proceeded smoothly; and the redoubt was completed in 1836 and the sea battery in 1841, and all but within the estimate), at an expenditure of £72,247. But Treasury Board adamantly refused to approve any expenditures for land purchases in Kingston; and thereafter land values climbed to a prohibitive level. In 1840, it was calculated that to acquire the lands required to implement the 1829 plan would add £100,000 to the cost of the project. This effectively ended any prospect of completing the 1829 plan, if indeed the Treasury had ever had any intention of approving further construction. The
January 1832 compromise agreement secured Treasury Board approval for the construction of the Fort Henry redoubt; but thereafter each of the works required to complete the 1829 plan had to be submitted separately to Parliament for approval, and Treasury Board had not made any commitment to support subsequent requests for funds. Moreover, Fanshawe and Lewis in their July 1828 report, had warned that the land required for defence purposes should be purchased immediately as prices would soar once the plans of the Ordnance became known; and yet the Lords of the Treasury refused to authorize the land purchases required.48 Whatever the case, the Ordnance was unable to complete the 1829 plan which had been devised to provide a secure defensive perimeter around the naval dockyard, the existing Commissariat stores, and the entrance to the Rideau Canal at Kingston. In consequence, all aspects of the Kingston plan had to be re-examined in the context of the Ordnance programme of constructing permanent fortifications; and this was all the more so as in March 1840 the Colonial Secretary, Lord John Russell, ordered that all of the new construction projects contemplated by the Ordnance for carrying out the 1825 Smyth Commission recommendations were to be deferred pending a re-assessment of North American defence priorities.49

In the ensuing exchange of views between the military and the government on the subject of Canadian defence needs, both the recently completed Rideau Canal and the Kingston defences figured prominently as a decision was sought as to whether the new Commissariat stores depot for Upper Canada should be constructed at Kingston as planned or erected elsewhere, and whether the naval dockyard at Kingston should be closed down or provided with an adequate defence. These questions, of course, were first raised as early as November 1827 when, in support of his argument in favour of constructing the Rideau Canal as a large lock steamboat navigation, Lt. Col. By recommended that both the
Commissariat stores depot, and the naval dockyard, should be removed to the security of the Ottawa River at By Town from Kingston where they were exposed to enemy fire. The Ordnance, however, had decided to keep the supply depot and dockyard at Kingston as evidenced by the 1829 plan of defence for Kingston; but the failure to carry out that plan revived both questions. Indeed, the dockyard question had engaged the attention of the Ordnance and Admiralty as early as 1831; but it was the commissariat problem that was the first to be resolved following Russell's call for a re-assessment of the programme of constructing permanent fortifications.

In March 1841, both the Commanding Royal Engineer in Canada, Lt. Col. J. Oldfield, and the Commander of the Forces, Lt. General Sir Richard Jackson, recommended that the projected Commissariat depot for Upper Canada should be constructed at By Town rather than at Kingston on Point Henry as was anticipated in the 1829 plan. In the former location, they submitted, the commissariat stores and arsenal would be much more secure and defensive works could be more cheaply constructed there than at Kingston. Indeed, Lt. Col. Oldfield, in an argument reminiscent of that developed earlier by Lt. Col. By, went so far as to recommend that By Town should be made the strategic centre for the defence of Upper Canada; and that Kingston and Montreal should be dependencies of By Town and supported from there if attacked. By Town, he declared, was centrally located and, following the completion of the Rideau and Ottawa canals, was favoured with secure, and relatively cheap and speedy communications in either direction, as well as being in communication with Lake Huron via the upper Ottawa River-Mattawa River (fur trade canoe) route; and the town and its communications links were as far as 100 miles removed from the frontier. However, in 1841 the incumbent Master General of the Ordnance, Sir George Murray decided that since Kingston had to be defended to prevent an enemy
force from descending down the St. Lawrence against Montreal, the stores depot and arsenal should be constructed as an integral part of the Kingston defence complex such as it was. Consequently, casemated commissariat stores were added to the seaward side of the Fort Henry redoubt interconnecting with the advanced sea battery. The Commissariat stores were commenced 24 June 1841 at an estimated cost of £12,527.18.6, and completed on 12 November 1843 at a cost of £10,632.5.9\textsuperscript{½}, and were the first of the Ordnance projects undertaken in keeping with the Smyth Commission report to be completed within the estimate. Both works had been anticipated in the 1829 Bryce Committee plan which had recommended that they be constructed at some future date; but neither work was included in the 1829 estimate for the Kingston fortifications. Although the defences of Kingston were to be by no means as secure as intended by the framers of the 1829 plan of defence, the decision to construct the Commissariat stores depot there determined that Kingston was to remain the military communications and logistics centre for Upper Canada in keeping with that plan. But the question of whether to close or properly defend the Kingston naval dockyard proved much more difficult to decide.

The dockyard question was relatively complex as it involved the larger question of whether large sums of money could, or should, be expended on constructing additional permanent fortifications, and of the role to be accorded to the navy in the defence of Upper Canada. To that end, it required taking into account the strategical impact of the completion of the Rideau Canal-Ottawa canals communication system and recent developments in naval operations on the Great Lakes. Where naval operations were concerned Lt. Col. By had advocated what was in effect a dual role for the navy: convoy duty for the protection of vessels transporting troops and supplies in support of military operations; and regular fleet operations to secure and maintain navy
supremacy on the Great Lakes, or at least on the most strategically important of the lakes, Lake Ontario. He had argued that if the Rideau Canal were built as a steamboat navigation then commercial steamboats could be armed and used for transport duties in place of the gunboats propelled by sail and oar; and that the cheapness, ease and speed of communications provided by steamboats operating on the Rideau Canal, not to mention the security from attack of the latter, would effectively eliminate the horrendous costs and difficulties encountered by the British forces in carrying out naval operations on the Great Lakes during the War of 1812. If this advantage were improved still further through the construction of locks on the Rideau Canal sufficiently large to enable warships to be constructed in the perfect security of the Ottawa River at By Town and towed through the canal to Kingston for service on Lake Ontario, Lt. Col. By believed the British navy would be able in any future war to contend with the Americans for control of Lake Ontario and, in effect, to provide naval protection for the steamboats moving troops, ordnance, and supplies to the defence of York and the Niagara peninsula or to meet American forces in the field.  

The June 1828 decision of the Kempt Committee in favour of constructing the Rideau Canal with locks 33 by 134 feet, instead of the 50 by 150 foot scale recommended by Lt. Col. By, had eliminated the option of transferring the naval dockyard to By Town; but the advantages of a steamboat navigation had been secured. Henceforth if regular fleet operations were to be conducted on Lake Ontario, the Kingston dockyard would have to be maintained and efforts made to obtain government support for the construction of an adequate defence. The first task facing the military, however, was to re-examine and up-date the plan of defence for North America in light of the fortifications and canals completed to that date, and in particular to assess whether the advantages realized through constructing the Rideau Canal as a steamboat navigation were
sufficient to alter the naval situation on the Great Lakes as drastically as Lt. Col. By had believed it would.

All of the military commanders who were initially involved in the post-1840 re-assessment of the Duke of Wellington's 1819 defence strategy (viz. Lord Hill, who had succeeded Wellington as Commander-in-Chief of the Army in January 1828 and was to be succeeded, on his death in August 1842, by Wellington in turn; Sir Richard Jackson, the Commander of the Forces in Canada; and Sir George Murray, the Master General of the Ordnance), concurred in Wellington's basic premise as to the necessity of constructing a line of permanent fortifications in conjunction with the development of water communications in the Canadian interior to provide secure lines of communication and supply. They were convinced that enemy forces could not be prevented from crossing the frontier in force; and that the best strategy of defence remained, in keeping with Wellington's earlier view, to rely on strong strategically sited fortresses which could serve as secure supply depots and garrisons for bodies of troops sufficiently numerous to deter an invading force from advancing into the interior out of fear of exposing its rear to attack.54 As envisaged by the Smyth Commission in 1825, and the Ordnance thereafter, the line of permanent works once constructed would enable a small army of regulars, aided by an active and numerous militia, to successfully repel any attack on the Canadas.55 In sum, as of 1840, the leading military commanders continued to propound, and believe in the efficacy of, Wellington's 1819 strategy of defence and were not prepared to propose an alternative scheme of defence. They took this position despite the fact that Treasury Board had long since refused to approve the construction of the additional works required to render Wellington's plan viable, and that recent border clashes in Upper Canada had necessitated the improvisation of defences which were more in keeping with an older
strategy of defence. The only new concern expressed in the thinking of the military commanders was their determination to develop a secure defence for the Rideau Canal which Lord Hill considered "may be justly estimated as the most useful and important work in design and execution that has been undertaken for the prosperity and security of Canada." Indeed, it was accepted as a maxim that the preservation of the Rideau Canal had to be "a primary object" of any plan of defence that might be adopted;\(^56\) and steps had already been taken to strengthen its defences.

In the aftermath of the 1837 rebellions, the efforts of the Hunters' Lodges to organize irregular forces in the United States for the invasion of Canada had forced the military authorities to raise militia units and deploy regular troops to meet the threat. However, in view of the absence of any permanent fortifications or effective interior water communications system west of Kingston, the military had been forced to revert back to the War of 1812 strategy of constructing, and garrisoning, a string of small temporary works and blockhouses scattered along the frontier to defend Canadian territory in conjunction with naval forces patrolling the Great Lakes to cut off any invasion force that might cross the lakes. Naval patrols were also used to provide protection for the vessels employed in moving troops and supplies up the lakes from Kingston.\(^57\) Although the Rideau Canal had long since replaced the upper St. Lawrence River route as the vital communications link between Montreal and Kingston, defences were developed and blockhouses constructed along the upper St. Lawrence much as they had been during the War of 1812 with the aim of protecting the St. Lawrence Front settlements from attack, as well as preventing marauders from penetrating inland towards the Rideau Canal.\(^58\) This defence scheme, of course, contrasted sharply sharply with the Ordnance's plan which had provided for defensible lockmaster's houses or blockhouses to be constructed directly at the locksites to
protect them from any marauders who might succeed in penetrating that far inland. Nonetheless, especially vulnerable points on the canal, such as the high dam at Jones Falls and the waste weir dam at White Fish Creek either of which if destroyed would have stopped the navigation for an extended period of time, were afforded a more direct protection in keeping with the plan favoured by the Ordnance and Lt. Col. By. Guardhouses were erected at both Jones Falls (constructed October 1838-January 1839) and the White Fish dam (November 1838-January 1839), and were garrisoned by local militia units as well as, for a time, regular troops of the 71st infantry Regiment. Regular troops and militia were also stationed in the blockhouses that Lt. Col. By had erected at Kingston Mills, the Isthmus, the Narrows and Merrickville, as well as in the barracks at By Town;\(^59\) and stone defensible lockmaster's houses, capable of withstanding musket fire, were constructed at three lock sites (Old Slys, Clowe's, and Nicholson's).\(^60\) The incomplete defences at Kingston, of course, were garrisoned and provided protection for the southern entrance of the canal;\(^61\) but Sir Richard Jackson, the Commander of the Forces in Canada, had recommended in 1840 that the Rideau Canal defences should be strengthened further by the construction of a substantial permanent fortress at By Town.\(^62\) Here matters stood in March 1841 when, with the invasion crisis over, Lord Hill requested the Duke of Wellington's views on what steps were required to effectively strengthen the Canadian defences. In particular, Hill informed Wellington that the principal objectives in view were to determine if additional works were required to secure the three key positions of Quebec, Montreal, and Kingston, and how best to protect the Rideau Canal, which if destroyed or interrupted would make it impossible to defend Upper Canada.\(^63\)

Instead of commenting on the immediate objectives in view, Wellington in his reply reverted back to his 1819
strategy of defence and advocated that the programme of construction required to render it viable should be completed in keeping with the plans (and inexplicably, the estimates) submitted by the Smyth Commission in 1825. Although the United States had become a great military power since the War of 1812, and had developed a navy "almost second" to that of Great Britain, Wellington was convinced that if his system were fully developed, Canada could be successfully defended with but little drain on the military resources of the mother country in time of war. To Wellington's mind, the key objectives were to maintain British naval supremacy at sea and in the lower St. Lawrence River, and to develop secure lines of communication and supply between the frontiers of Upper Canada and Quebec. To that end, he recommended that the defences of Halifax harbour should be pushed to completion (the citadel, on which work commenced following the July 1828 compromise, was still under construction); and that work should commence on the proposed citadel at Montreal to protect the line of communications, via the Rideau Canal, with Upper Canada. Thereafter, the fortress at the Short Hills should be constructed to protect the Niagara frontier and the Welland Canal; as well as the fortified barracks proposed earlier for Chatham in the western peninsula of Upper Canada. Moreover, not only did Wellington recommend that funds be allocated thereafter to construct the remainder of the permanent fortifications recommended in the Smyth report; but he stressed that the canals he had proposed for the interior of Upper Canada in 1819 should be constructed at an early period to connect up with the existing water communications, with railways to be established where it was not possible to construct canals. More immediately, he was anxious that the canal from the Bay of Quinte to Lake Simcoe should be undertaken so as to provide a secure internal line of communication from Kingston to the rear of York independent of Lake Ontario.64
Where canal communications were concerned, Wellington was at one with Lord Hill in holding that the Rideau Canal was the *sine qua non* for the defence of Upper Canada. It was obvious that the upper St. Lawrence River route could not be used as a supply route in wartime, and if the Rideau Canal were interrupted or destroyed, it would be impossible to maintain an army in Upper Canada. Indeed, Wellington was as convinced as ever that the defence of Upper Canada was totally dependent on the facility of water communications and especially the speed with which troops, stores, and field equipment could be moved from one part of the country to another. In words reminiscent of Lt. Col. By's earlier arguments in favour of constructing the Rideau Canal as a large lock steamboat navigation, he gave his view that the speed and ease of the water communications would be the critical element in the defence of Upper Canada if extensive military operations were to be carried out there. To that end, he recommended that the three small locks of the Grenville Canal on the Ottawa River and the small locks of the Lachine Canal should be enlarged to the size of the Rideau Canal locks to eliminate the need for transshipping goods and passengers there; and that steam tugs should be shipped to Canada and deployed on the waterways in sufficient numbers to ensure there would be no delays in moving troops and supplies from Quebec to Kingston.

Wellington had at one time opposed Lt. Col. By's arguments in favour of constructing the Rideau and Ottawa River canals on a larger scale to serve as a steamboat navigation; but by 1841, he was a convinced advocate of their strategic importance as well as being conscious of the economic implications of steamboats where military transport costs were concerned. In the spring of 1828, the Ordnance had prepared figures on transport expenditures, incurred during the War of 1812, which were submitted to Parliament in support of the request for parliamentary approval of the additional monies required to construct the Rideau Canal.
with large locks capable of accommodating steamboats. Those figures showed that the cost of transporting military and naval stores from Quebec to Kingston via the difficult upper St. Lawrence route was £104,634 in 1813, £192,477 in 1814, and £341,215 in 1815; and it was estimated that the completion of the Rideau Canal as an uninterrupted steamboat navigation would reduce the cost of transport in the ratio of fifty pounds to one. Wellington, of course, at that time was Prime Minister and First Lord of the Treasury, and could not but have been aware of the economic implications of constructing the Rideau Canal as a steamboat navigation. In any event, he was convinced that the June 1828 decision to construct the Rideau Canal with locks sufficiently large to pass steamboats was more than justified, and was moved to declare that:

However expensive the works upon the Rideau, nobody now doubts the wisdom of the plan, its efficacy, and above all, its economy.68

In Wellington's view the completion of the Rideau Canal had effectually eliminated the major disadvantage under which the British military had laboured during the War of 1812 (viz. the vulnerability, difficulty and high cost of transport on the upper St. Lawrence route), and transformed the military situation to the point where the defence of the province could be undertaken with some prospect of success which was decidedly not the case hitherto. Likewise, the existence of the Rideau Canal improved immeasurably the naval situation on the Great Lakes through relieving the Admiralty of the necessity of relying on the upper St. Lawrence River route. But where naval operations on the lakes were concerned, Wellington remained convinced that the advantages that the Americans continued to enjoy (viz. the proximity of their naval and military arsenals to the lakes; the relative ease of American communications with the lakes; and the numerous ports on the American side), were still such as to preclude British naval forces ever gaining an
equality of naval strength with the Americans. Clearly, where naval operations were concerned Wellington did not share Lt. Col. By's belief that the advantages conferred by the Rideau Canal steamboat navigation were sufficient to enable the British navy to engage in a shipbuilding race with the Americans for control of the Great Lakes, or on a more limited scale for naval supremacy on Lake Ontario. Hence, Wellington's continued insistence that his proposed system of interior water communications should be constructed so as to enable the army to operate independent of the lakes to the west of Kingston. As made clear at an earlier date, he was convinced that a fleet of warships would not be required on the lakes in any future war; and that the role of the navy should be confined to keeping a small naval establishment at Kingston so as to maintain the dockyard, naval stores, and guns required for arming the commercial steamboats to be requisitioned for transport duties on the outbreak of war. In effect, Wellington accepted Lt. Col. By's earlier argument that steamboats were the most efficacious means for moving armies in Canada; but he continued to adhere to his 1819 strategic outlook whereby Canada was to be defended solely by military means with the navy, despite the revolutionary transformation in the speed and cost of transport effected by the Rideau Canal, being reduced to playing a subordinate and strictly supportive role in aid of army operations.

The programme of construction that Wellington urged on the government in March 1841, consisted basically of the class one works which had been submitted to Parliament for approval in the spring of 1828, to which Wellington now added a recommendation that work should commence on building an extensive system of interior canals to the west of Kingston commencing with the Bay of Quinte-Lake Simcoe communication. Yet, Parliament had already rejected all but the Halifax citadel and the Kingston fortifications projects from among the class one works proposed for construction by
the Ordnance in 1828, and as of 1841 funds were being denied to complete the Kingston project approved in 1828. What is more, the system of interior canals, although an integral part of the strategy of defence developed by Wellington in 1819, had not been included in the works that Major General Smyth had recommended for construction in 1825, or even mentioned in the second and third class works that Parliament had been informed in 1828 were to be postponed indefinitely; and now Wellington was advocating that funds be allotted not only for construction of these canals and most of the class one fortifications, but also for the eventual construction of the remainder of the permanent fortifications programme set forth in the Smyth report in spite of the fact that no government, including his own, had ever dared to submit these works to Parliament for approval. Whatever the merits of Wellington's recommendations from a military viewpoint, there was no doubt that an immense sum would be required to carry them out. As of 1828, the engineering estimates for the fortifications programme totalled £2,335,544 and all of the projects undertaken, with the exception of the truncated Kingston project, had incurred substantial cost overruns; and the system of interior canals, which had never been estimated even for construction with 20 foot locks suitable to accommodate gunboats in keeping with the original plan, were now it would appear to be constructed on a larger scale to pass steamboats. Needless to say, the Colonial Secretary was not inclined to follow such advice, and approval was not forthcoming for expenditures on additional defence projects in Canada.71 But the press of events and new developments in naval warfare soon forced the British government to re-address the Canadian defence problem, and in particular the inadequacies of the dockyard and Rideau Canal defences at Kingston.
A New Strategic Outlook?
The British Admiralty had been convinced from the close of the War of 1812, that it was impossible to best the Americans in a shipbuilding race for naval supremacy on the Great Lakes given the advantages they enjoyed and the horrendous difficulties and costs of the upper St. Lawrence transport route. However, rather than viewing the completion of the Rideau Canal as a substantial aid in conducting future naval operations on the lakes, it was seized upon as a justification for withdrawing totally from the Canadian interior. The Admiralty had maintained that the speed and facility of steamboat transport between Quebec and Lake Ontario made possible by the Rideau Canal was such that the stores of naval supplies, equipment and guns required to arm transport vessels for service on the lakes could be readily forwarded from Quebec in the event of war and no longer had to be stockpiled at Kingston; and the dockyard was held to be of little use as ships could not be constructed there in war time unless it were properly fortified. Consequently, in December 1833 the naval establishment at Kingston had been reduced and the dockyard closed in the following March. Thereafter, the Admiralty had given over its lands in Kingston to the Ordnance and proceeded to sell off the rotting hulls of the gunboats and frigates that had been mothballed at Kingston since the termination of the War of 1812. Here matters had stood until developments subsequent to the 1837 rebellions proved that a naval presence on the Great Lakes was not to be so easily discarded, regardless of the disadvantages of the British position and the prevailing strategy of defence which envisaged a strictly military defence of Upper Canada.

When the Hunter's Lodges, following the 1837 rebellions in the Canadas, threatened to launch invasion forces across the Great Lakes, the Admiralty was forced to take preventative action for the defence of the Upper Canada; and
to that end, a naval detachment under Captain William Sandom had been despatched early in 1838 to Kingston to re-open the naval dockyard. On his arrival, Captain Sandom repurchased a schooner and three former naval gunboats from their private owners, and proceeded to lay the frames for the building of three new gunboats for service on Lake Ontario. Captain Sandom requisitioned one steamboat, the Coburg, for transport duties and prepared plans for the construction of another steamer; but appears to have believed that gunboats would be the mainstay of his naval force as he recommended that thirty gunboats should be constructed for service on Lake Ontario. Nonetheless, as Lt. Col. By had anticipated, steamboats proved far superior to gunboats as transport vessels in the one major engagement, the Battle of the Windmill at Prescott in November 1838, in which they were both engaged. The superiority of steamboats was so evident that within two years of their being put back into service the old gunboats were scrapped; and the Admiralty, in recognizing that steamboats had rendered gunboats propelled by sail and oar obsolete, moved beyond the arming of commercial steamboats for transport duty to the construction of steam warships. In 1840, a paddle-sloop, the H.M.S. Minos, was constructed at Chippewa for service on Lake Erie; and thereafter two paddle-sloops, the H.M.S. Cherokee and H.M.S. Mohawk, were built at the Kingston dockyard. At this juncture, the military authorities were still thinking in terms of a strictly military defence for Upper Canada as reconfirmed in Wellington's assessment of March 1841. The government, of course, had refused to accept Wellington's recommendations and declined to authorize further expenditures on permanent fortifications in the Canadian interior; but when the Americans launched a large (582 ton burthen) iron steamboat, the sidewheeler U.S.S. Michigan, on Lake Erie in 1843 and the next year undertook the construction of a second warship of the same description at
Oswego on Lake Ontario, the inadequacies of the Canadian defences could no longer be ignored. These vessels threatened to revolutionize naval warfare on the Great Lakes in that once fully armed they assured the Americans of an overwhelming superiority over the make-shift British fleet of armed commercial steamboats, paddle-sloops, and the several surviving gunboats constructed in 1838.

The immediate response of the British government took the form of a note, delivered in Washington on 23 July 1844, protesting that the launching of the U.S.S. Michigan had violated the terms of the Rush-Bagot convention of 1817 which had limited the respective navies of Great Britain and the United States on the interior lakes to a total of four vessels, each of less than 100 tons burthen and armed with one 18 pound cannon. Neither the British government, nor the Americans as it turned out, were convinced that the convention applied to steamboats; but the launching of a war vessel of the size of the U.S.S. Michigan and the manufacture of shot and shells for the same was regarded as being completely contrary to the spirit of the agreement and an unfriendly act that could not be ignored. Lord Stanley, the Colonial Secretary in the Conservative government of Sir Robert Peel, was adamant that Canadian trade on the lakes should not be left totally at the mercy of the American ships of war; but the problem was how to achieve that objective. Stanley was well aware that the Kingston naval establishment had been severely reduced in keeping with the basic premise of Wellington's defence plan; viz. that the local advantages enjoyed by the United States precluded Great Britain ever attaining a naval supremacy on the lakes in any shipbuilding race; and that little had been done, because of the enormous expenditures that would have been required, to construct the structures designed to implement Wellington's strictly military defence system which might otherwise have deterred the Americans from engaging in hostile acts. While awaiting the American response to the
British protest, Lord Stanley approached the Prime Minister to decide on a course of action.81

Although the Duke of Wellington was a member of cabinet in the Conservative government and once again Commander-in-Chief of the Army, Sir Robert Peel nonetheless dismissed out of hand any idea of completing the fortifications system as recommended by Wellington in March 1841. Peel believed that permanent fortifications were objectionable on several counts including their great cost; the length of time required to construct them (the Halifax citadel commenced in 1828 was still under construction); and the uncertainty as to what should be constructed when the introduction of "novel methods of attack" might well render whatever was constructed obsolete several years hence. But most importantly, he was convinced that in view of the political discontent rife in the Canadas, any major expenditures on military defences was but money thrown away; and he was in accord with those who contended that any effort to engage the Americans in a shipbuilding race to place war vessels on the lakes was bound to result in Britain being beaten. In such a situation, the only practicable response was a diplomatic initiative to convince the Americans that steam warships were, or ought to be, covered by the terms of the Rush-Bagot agreement. In the interim, Sir Robert decided to accept the offer of a private Canadian company to construct three commercial steamboats at Kingston, which, in return for a government contribution toward their construction, would be turned over to the British navy in the event of war and armed for service on Lake Ontario. This effort, it was realized, would in no way challenge the American naval supremacy on the lakes; but it would at least give the appearance of an effort to place a respectable naval force on the lakes and was an economical response that would leave the warships question open pending the results of the diplomatic initiative. If that initiative failed, then the government was prepared, rather
reluctantly, to initiate a programme of counter-armaments; and to that end, the Ordnance was requested to express its views on the Canadian defence situation.  

For the military authorities, Kingston at the head of the communications system connecting Upper Canada (known also after 1841 as Canada West) with the sea at Quebec was second in importance only to the latter where the defence of the Canadas was concerned; and repeated efforts had been made to secure approval to complete the Kingston fortifications in keeping with the 1829 plan of defence. But successive governments had refused to allocate funds for further construction following the completion of the commissariat stores in 1843; and in April 1844, the Treasury Board had ruled that no monies were henceforth to be expended on land purchases in Kingston. This effectively eliminated any possibility of constructing defences to the west of Kingston, where the land was in private hands, as all of the lands in Ordnance hands to the east of the harbour were needed for the proposed eastern defences and were not available for a land exchange. The eastern defences, however, were decidedly the most important as they would protect the Rideau Canal and the dockyard from an American attack launched along the natural invasion route from Sacketts Harbour on Lake Ontario through the screen provided by the Thousand Islands to the Canadian shore where troops could disembark for an attack from the east.  

In concentrating on defending the eastern approach, the military authorities were in effect returning to the plan of Major General Smyth, with the exception that they were convinced that the two additional redoubts and two flanking towers, proposed by the Bryce Committee in October 1829 for the eastern approach, were necessary to prevent an American force crossing the peninsula behind Fort Henry to cut off the Rideau Canal communications system and attack the dockyard from the rear. The Fort Henry redoubt was adjudged no more capable of preventing troops passing to its rear,
beyond the range of its guns, than the fort that Major General Smyth, in his 1825 report, had recommended for construction on Point Henry. Nonetheless, the government had refused to approve even the construction of the eastern half of the 1829 defence plan or the erection of the additional batteries required to defend the sea approaches. Indeed, in the absence of a British fleet on Lake Ontario and/or a large field army, there was nothing to prevent an American force landing either to the east or west of Kingston harbour and penetrating inland to cut off the Rideau Canal communication, and destroying the dockyard by bombardments while all the time remaining out of range of the guns of Fort Henry and the existing sea batteries. The military authorities, however, had expounded at length for years on the inadequacies of the Kingston defences, and Canadian defences in general, all to no avail; and the Ordnance's views on Canadian defences, embodied in Sir George Murray's memorandum of 27 September 1844 to the effect that Kingston could not be held against a combined military and naval assault, would probably have evoked little response on the part of the government had it not been for subsequent political developments in the United States which raised the spectre of an Anglo-American war.

In November 1844, James K. Polk was elected President of the United States and in his inaugural address the following January, re-affirmed his determination to resort to war against Great Britain, if necessary, to secure American control over the whole of the disputed Oregon territory on the west coast. This was a threat that the British government could not ignore. Lord Stanley, following through on his earlier concern over the placing of American steam warships on the Great Lakes, ordered that plans be prepared to strengthen the defences of the Kingston dockyard and Rideau Canal entrance against a naval attack, and had an Admiralty employee despatched to Kingston to supervise the conversion into gunboats of the three
steamboats to be constructed by the Niagara Harbour and Dock Company. He also called for an inventory to be taken of the naval stores and ammunition stockpiled in Canada. More generally, surveys were undertaken for the building of a military road intended to provide a winter communications route for the transport of troops and supplies from the ice free port of Halifax to Quebec. Once built, that road by supplementing the water transport system, would serve to secure an effective year round communications with the sea. All of these efforts foreshadowed a change in the strategy of defence where Canada was concerned. Whereas the 1829 plan of defence for Kingston had envisaged the construction of a number of casemated redoubts, towers, and enclosed sea batteries which when manned by relatively small garrisons would have been capable of securing both the land and sea approaches from being carried by attack; the new defence plans, submitted on 12 June 1845 by Colonel Holloway, the Commanding Royal Engineer for Canada, focussed on defending the Kingston complex from a naval attack in keeping with Lord Stanley's instructions and presupposed the presence of a large, mobile, field army to defend the land approaches. Not only was the land required for the erection of additional sea defences already in the hands of the Ordnance, which was not the case with the land that would have been required to complete the landward defences; but the introduction of steam warship necessitated the strengthening of the Kingston complex against a naval attack. Sailing warships would have been deterred from attacking Kingston harbour because of the difficulty of extricating themselves against the strong prevailing wind blowing in from the lake, and even if they did attack, were incapable, in view of their limited manoeuvrability independent of the wind, of maintaining a heavy stationary bombardment against the shore installations. This was decidedly not the case with steam warships whose
manoeuvrability rendered light harbour defences inadequate. 93

The Holloway plan called for the strengthening of the existing sea battery on Point Frederick to complement the recently constructed sea battery of Fort Henry, the construction of an additional sea battery on the west side of the harbour near the Market House of Kingston, and the erection of four Martello towers dispersed at key locations on the sea approaches at an estimated total cost of £51,000. On the west, or Kingston side, of the harbour, the sea approach was to be defended by a Martello tower on Murney's Point (Murney Tower) in place of a sea battery and tower proposed in the 1829 plan, and by the proposed Market House sea battery (Market Battery) closer to the inner harbour with a Martello tower (Shoal Tower) on a shoal in front of the market battery a short distance removed from Mississauga Point which was no longer available for use. These works were intended to cover the harbour entrance to the Rideau Canal and the Kingston anchorages as well as provide supporting fire for the Point Frederick battery in defending the naval dockyard. To the east side of the harbour, the existing sea battery on Point Frederick was to be enclosed and a tower added (Fort Frederick Tower); and a tower was to be erected on Cedar Island (Cedar Island Tower) as provided for in both the 1825 and 1829 plans of defence although re-located toward the west end of the island. The Martello towers, armed with two 32 pounder guns on top and generally two 32 pounder carronades within, were to act in conjunction with the sea batteries of Fort Henry and Point Frederick to protect the dockyard. Although Martello towers were not the best means of defence that could have been devised for Kingston, they could be erected relatively quickly and cheaply to meet the emergency created by the Oregon crisis, and were in keeping with the expressed unwillingness of the British government to expend large sums on permanent land fortifications. 94
The Holloway plan for the defence of Kingston against a naval assault or bombardment, was approved by Lord Stanley in August 1845 for inclusion in the Ordnance estimates to be submitted to Parliament in the next year; but in December 1845, Lord Cathcart, the Governor General and Commander of the Forces in Canada, fearing that a successful American surprise assault on Kingston would cut off the British forces deployed in Upper Canada, ordered the work to proceed and be paid for out of the military chest pending the approval of Parliament. The various fortifications were commenced shortly thereafter by private contractors who submitted tenders totalling £47,787.6.10½. By 1848, all of the fortifications were completed, although not armed, at a cost of £53,944 for a cost overrun of only £2,994 or 5.87 percent on the initial estimate. During the same time period, two small towers, each to be armed with one 24 pounder on top, were constructed at an estimated cost of £6,262 at the extremity of the branch ditches connecting Fort Henry with the water's edge (East Branch Ditch Tower, West Branch Ditch Tower); and the defences of the Rideau Canal were strengthened.

During the 1840s, the first line of defence for the Rideau Canal was still the upper St. Lawrence River Front centered on Fort Wellington near Prescott, with a second line of defence centered on the town of North Augusta, a mustering point for the local militia some 12 miles in the interior. One of the two main roads connecting the St. Lawrence with the Rideau Canal, the Prescott Road commenced near Prescott (more accurately at Maitland) on the St. Lawrence River and passed through North Augusta after which it branched off with one fork leading to Merrickville on the Rideau Canal, some 30 miles inland from the St. Lawrence, and the other fork leading to Kemptville on a navigable branch of the Rideau Canal. That road had been constructed by the Province of Upper Canada in 1832 much to the annoyance of the British military authorities
who preferred a virtually impenetrable wilderness buffer to be left between the settlements on the St. Lawrence Front and the Rideau Canal communication in the interior. 98 Hence at the time of the Oregon crisis, the military was concerned not only with defending the canal against the musketry of small bands of marauders bent on destroying the canal works, a long standing problem, but also a new concern: how to prevent American regular forces from penetrating to the several locksites that could be reached by road; and how best to defend the vulnerable locksites against the light artillery which such a force would possess. 99 On the Rideau Canal, the military did not have to be concerned about patrolling along the whole length of the navigation to prevent its being destroyed. Unlike conventional canals which could be filled in or breached at almost any point, the Rideau, consisting of canalized rivers and lakes, was vulnerable to damage only at the dam-lock sites; 100 and a good many of these locksites were still inaccessible by road or too remote from the frontier to be attacked in force. This, of course, greatly facilitated the defence of that waterway.

To meet the two distinct threats posed to the security of the Rideau navigation by marauding bands on the one hand and American regular forces on the other, Col. Holloway determined that two different approaches were required. In February 1846, he recommended that the more isolated lockstations should be strengthened by adding loopholes to the lockmasters' houses and outbuildings and enclosing them with palisades which would be sufficient to withstand the musketry of marauders; and that the more exposed lockstations should be defended by a Tower or other permanent fortifications "not exceeding the character of batteries with stockaded blockhouses as keeps." The blockhouses recommended for construction were to be similar to the four erected by Lt. Col. By in 1832 at Merrickville, the Narrows, the Isthmus, and Kingston Mills, respectively:
viz. with a lower storey of masonry supporting a heavy log upper storey capable of resisting light artillery fire. These stations were to be permanently garrisoned, with the less heavily fortified locksites serving as mustering points for the militia in the event of war; and it was recommended that the several roads leading into the interior from the St. Lawrence Front should be patrolled and preparations made to hinder an enemy's advance through destroying the roads or constructing abattis.\textsuperscript{101} (Abattis were formed by cutting down trees and placing them in such a manner as to thoroughly block up a road or an approach to a fortification.\textsuperscript{102}) Col. Holloway also suggested that the pivot of the second or interior line of defence should be moved from North Augusta to Merrickville which he believed should be made the center of all operations conducted for the defence of the canal.\textsuperscript{103}

The plan of defence that Col. Holloway recommended for the Rideau Canal represented in large measure a return to the original plan, devised by Lt. Col. By, of constructing blockhouses on the locksites to provide a protective fire for the locks and dams as well to serve as mustering points for the local militia; although Lt. Col. By had envisaged By Town becoming the strategic center of defence for the canal as opposed to Merrickville which Col. Holloway favoured, or the Irish Creek junction, some eight miles above Merrickville, which Wellington had designated as the best location for a garrison-depot in 1819.\textsuperscript{104} Lt. Col. By had planned to construct dual purpose blockhouses, to house the lockmasters as well as serve a military function, at each of the 22 locksites on the canal with a fort, fronted by a wet ditch, to be built on Barracks Hill to defend the By Town flight of locks and basin. On his own initiative, By had substituted blockhouses for lockmasters' houses at four of the most vulnerable locksites because of the savings that he was able to effect through proceeding to their immediate construction. As explained to Col. Durnford at
the time (14 January 1832), Lt. Col. By was anxious to construct blockhouses at all of the sites where lockmasters' houses had not been constructed as the contractors, while they had their men, tools, and equipment on site, had expressed a willingness to contract for the construction of blockhouses for a total of £800 each, rather than the usual cost of £1500, and by having the blockhouses serve a dual function, £300 could be saved toward their cost by eliminating the need to construct lockmasters' houses. However, as related previously, the cost overruns experienced during the construction of the Rideau Canal forced the postponement of the construction of any military defences beyond what Lt. Col. By had erected; and during the immediate post canal construction period, the military authorities had concentrated their efforts on seeking funds to construct the Kingston fortifications for the defence of the exposed southern entrance to the canal.

The Fort Henry redoubt, sea battery, and commissariat stores, complex was completed at Kingston by 1843; but otherwise no further military fortifications had been constructed on the Rideau Canal since 1838 when, as a result of the invasion threats of the Hunters' Lodges, guard houses were built at Jones Falls and the White Fish dam and three stone lockmasters' houses, capable of withstanding musket fire, were erected at Nicholson's, Clowe's and Old Sly's. As the Oregon crisis approached, the growing bellicosity of the United States moved the Ordnance to authorize the construction, in July 1844, of a defensible lockmaster's house at Chaffey's lock. This structure was similar to the three stone lockmasters' houses erected in 1838, but was loopholed with a tin fireproof roof; and it may well have been what Col. Holloway had in mind in February 1846 when he recommended that the lockmasters' houses constructed previously should be loopholed. With the onset of the Oregon crisis, Col. Holloway, as mentioned, developed plans for the construction of fortifications on the Rideau
Canal which were much more elaborate than the existing defences and no doubt would have entailed a far greater expenditure than the blockhouses that Lt. Col. By had proposed to construct. But the British government, which had continued during the Oregon crisis to rely on diplomatic initiatives to settle outstanding differences with the United States rather than having recourse to massive expenditures on land fortifications and/or large scale troop build-ups, managed to reach a settlement of the Oregon boundary dispute on 15 June 1846; and the following December, the new Whig government of Lord John Russell ordered all further fortifications projects to be deferred indefinitely.108

The removal of the threat of war and the concomitant political developments effectively stopped the implementation of Col. Holloway's February 1846 plan to strengthen the defences of the Rideau Canal through constructing major fortifications at key locksites; but did not lessen the determination of the military authorities to improve the canal defences insofar as possible. The Martello towers and batteries, which were under construction at Kingston for the defence of the southern entrance to the canal and the dockyard, were pushed on to completion; and with the removal of the threat posed to the canal by American regular forces, the military authorities concentrated the limited resources at their disposal in improving the canal's defences against marauders. Sometime between 1844 and 1852, an additional eleven defensible lockmasters' houses, modelled on the loopholed and tinned roofed Chaffey's lock structure, were erected on the Rideau Canal: viz. at Lower Brewer's, Upper Brewer's, Jones Falls, Davis, Poonamalie, Smith's Falls (one at the combined locks and another at the detached lock), Edmond's, Kilmarnock, Hog's Back, Hartwell's and By Town.109 In all, sixteen defensible lockmasters' houses were constructed along the Rideau Canal prior to 1852; but of these, the three original
structures constructed ca. 1838 at Old Sly's, Clowe's, and Nicholson's, do not appear to have been loopholed or palisaded as Col. Holloway recommended in 1846.\textsuperscript{110}

Whether the walls were loopholed or not, the defensible lockmasters' houses erected on the Rideau Canal in 1838 and thereafter were not, strictly speaking, fortifications so much as houses that were constructed in such a way as to be able to resist an attack by hostile forces unaccompanied by artillery. This was a standard military procedure that was in effect in the 1840s, if not long before, where the construction of buildings by the military was concerned.\textsuperscript{111} The settlement of the Oregon crisis removed any incentive for the British government to expend monies on permanent fortifications in Canada; and the last permanent fortifications to be constructed in the Canadian interior were those erected at Kingston for the defence of the southern entrance to the Rideau Canal and the naval dockyard against a naval attack in 1846-48. These structures, however, were not erected as part of a continuing effort to realize the programme of construction required to implement Wellington's grant strategy of defence; but rather were a stop-gap, economy measure necessitated by its failure to be carried out.\textsuperscript{112} When the whole scheme of construction was presented to Parliament for the first time in the spring of 1828, only two new works were approved, as mentioned, for construction in addition to the several works that had been approved in a piecemeal fashion at earlier dates. Of these two works, the Kingston fortifications project was quickly curtailed by the Treasury Board; although the Halifax citadel project was allowed to proceed to a completion.

Work on the Halifax citadel complex was begun in August 1828 at which time it was estimated the citadel would be completed in six years at a cost of £116,000.\textsuperscript{113} However, a faulty design and the collapse in December 1830 of several lengthy sections of escarp, caused by the failure
of the mortar to set properly in the damp climate, hindered the progress of construction. To remedy these difficulties, new plans were prepared, walls were thickened, larger stones cut and laid, and cement was used thereafter to point the joints in the face of the masonry. But the imposition of new standards of construction, the redrafting of plans and rebuilding of walls added greatly to the cost and duration of the project. When fully completed in 1856-60, some 29 years or more after it commencement, the Halifax citadel had cost £242,122. In effect, the project took almost six times as long to build as originally estimated, and incurred a cost overrun of 52 percent on the first engineering estimate submitted in December 1825 by Col. Nicolls, the Commanding Royal Engineer, Halifax. When work ceased on the Halifax citadel, it marked the end of the long since moribund programme of construction intended to implement Wellington's military defence strategy. Permanent fortifications were constructed thereafter at Halifax, but were intended to strengthen an important Imperial naval station rather than being an integral part of any plan for the military defence of British North America.

For better than two decades, the Board of Ordnance had struggled to secure government/Parliamentary approval for the construction of the fortifications and canals required to put in force Wellington's grand strategy of defence articulated in 1819, but with only a modicum of success. In all only six projects were ever approved: the Ottawa River canals (on which work proceeded from 1819 through to 1834), Fort Lennox (May 1819 to 1829), the Quebec citadel (May 1820 to 1831), the Rideau Canal (September 1826 to August 1832), the Kingston complex (1832 to 1843), and the Halifax citadel (1828 to ca. 1860); and by no means all were brought to completion as originally planned. Nonetheless, with the exception of the fortifications erected at Kingston, all of the construction projects carried on by the Ordnance in British North America contemporaneous with the Rideau Canal
project, incurred costs far in excess of both the preliminary and the first detailed engineering estimate for the works even though several of them: viz. Fort Lennox on Isle aux Noix and the Ottawa canals were not built on as extensive a scale as planned and estimated for; and it generally took far longer than estimated to complete the respective works despite the fact that, with the exception of the unstable sandy soil of Isle aux Noix which was subject to flooding, all of the structures were built for the most part, on solid ground that was easily surveyed, relatively close to labour and building supplies, and were subject to few unforeseeable contingencies. As related previously, the Ottawa canals project was conducted on a far smaller scale than the Rideau Canal project under immeasurably less trying circumstances and required 15 years of work; and yet incurred cost overruns in excess of 60 percent on the estimate made by the Kempt Committee members, in November 1828 some nine years after construction had commenced, and 38 percent on the supplementary estimate prepared for the works built by the superintending engineer, Col. Du Vernet of the Royal Staff Corps. Among the fortifications projects, Fort Lennox took 10 years to complete and may well have experienced a substantial cost overrun on the initial engineering estimate of £86,726; the Quebec citadel took 11 years to construct and costs ran 238 percent over the initial engineering estimate; and the Halifax citadel, a six year project, took some 29 or more years to complete and experienced cost overruns of 52 percent on the engineering estimate. In contrast, Lt. Col. By's cost overrun on his estimate for the size of locks actually constructed on the Rideau Canal was roughly 19.7 percent (making allowances for the cost of the waste weirs and other items which were not included in the June 1828 estimate). The fortifications constructed at Kingston were the only ones to be erected with little or no cost overrun on the engineering estimate; but the construction work
required on that project was nowhere as difficult or demanding as the Rideau Canal undertaking. (Indeed, if the Kingston project had been undertaken by the Ordnance in the same manner as the Rideau Canal, with binding contracts being entered into for all of the structures required to complete the Kingston fortifications complex and the work pushed forward prior to its being submitted to Parliament for approval, there is every reason to believe that Col. Wright would have found himself in an unhappy situation similar in at least one respect to that experienced by Lt. Col. By: viz. locked into large expenditures in excess of what Parliament was ready to accept for the project. However, work did not commence on the Kingston fortifications until the plans and estimate for the whole project were submitted to Parliament for approval; and that body forced the Ordnance to revise the plans and reduce the projected expenditures to a more acceptable level, and once the first stage of construction was completed, Treasury Board terminated the project. On the Rideau Canal, not only was the work commenced before Parliament was made aware of the engineering estimate for the project, but binding contracts were entered into for the whole of the work which was of such a nature that it could not be truncated to keep expenditures to a desired level without its being rendered useless.) Placed in the context of other Ordnance construction projects, it is evident that the cost overruns on the Rideau Canal were relatively minor relative to the size of the project and the cost overruns experienced elsewhere; however, what stood out was the magnitude of the sums expended on the Rideau Canal project.

The Rideau Canal was by far the largest project to be undertaken by the Ordnance and the sum expended, £822,804, was far greater than the sums expended at Isle aux Noix, Quebec, Kingston (prior to 1843 or indeed thereafter), Halifax, or on the Ottawa canals: viz. £86,726, £236,540, £82,879, £242,122, and £312,009, respectively; and the
Rideau Canal expenditures were made in a relatively short period of six years at a rate of about £150,000 per year over the last four years of the project, in contrast to the other projects whose costs were spread over a period of from 10 to 15 to even 30 years. Lt. Col. By always maintained that he had constructed one of the finest canals in North America, anywhere from 15 to 20 to 25 percent more cheaply than any comparable work; and what is more, that he had succeeded in constructing in six years what in the normal course of construction would have taken 20 years to build. Judging from the other projects undertaken by the Ordnance, this statement appears to be all too true; but ironically, Lt. Col. By was betrayed by his own diligence and efficiency in carrying out his instructions to push on the construction of the Rideau Canal to completion as rapidly as possible. Had he been slower to layout the Rideau Canal works and conclude the contracts for their construction, the canal might well have taken two decades to construct with the expenditures spread over a far longer period; and the Treasury Board would not have been faced with the cost overruns on the approved estimate which led them to question By's competence and demand his recall in the spring of 1832. What is more, if By had not succeeded in concluding contracts for all of the works at a relatively early date, February 1828, he would have remained at liberty to postpone the uncontracted work when the Ordnance in the spring of 1828 became concerned about the scale of his expenditures. But to the contrary, Lt. Col. By had made every effort to get the work underway as quickly as possible in keeping with his instructions; and, as the Ordnance was well aware, once all of the contracts were signed, he was effectively deprived of any means of slowing down the pace of the work or consequently the rate, and amount, of his expenditures.

The contract system, as the Ordnance realized upon its adoption for the Rideau Canal project, made for a much
faster pace of construction than the more traditional day work system as the contractors were free to commence their work as soon as possible each spring and push on quickly thereafter without fear of their work being curtailed if the rate of progress, and the resultant payments received, should outrun the amount of the annual parliamentary grant for the project; but it was Lt. Col. By, ably assisted by his engineering staff, whose exertions enabled the work to be quickly undertaken and prosecuted at a rapid rate with a minimum of delay or indecision.

Had the contract system been fully employed on the other Ordnance projects and the works placed under Officers as competent and zealous as Lt. Col. By with orders to push on the works as quickly as possible, large expenditures would have been made in a much shorter period of time than they were; and they may well have equally raised the ire of the Treasury Board. In retrospect, it is clear that it was the substantial sums expended on the Rideau Canal, and the rapid rate at which the large expenditures were made, that drew the anger of Treasury Board and brought about Lt. Col. By's recall rather than any alleged incompetence or the relatively small cost overrun incurred. There may well have been gross incompetence in evidence elsewhere on other Ordnance construction projects, and perhaps extravagant expenditures; but that was certainly not the case on the Rideau project. As related elsewhere, Lt. Col. By, far from engaging in extravagant expenditures, actually by his astute planning, engineering decisions, and superior organizational abilities, managed to keep the Rideau Canal construction costs under a strict control when in the circumstances under which the project had to proceed, they might well have soared far beyond what he expended; although it is true that Lt. Col. By did increase the cost of the Rideau Canal somewhat through convincing the Ordnance, and subsequently the British government, that it should be constructed with larger locks than originally planned.
Lt. Col. By was responsible for convincing the Ordnance, over the initial objections of the former Master General, the Duke of Wellington, and Major General Carmichael Smyth, that the Rideau Canal should be constructed with larger locks than the 20 foot wide by 108 feet long gunboat locks to enable steamboats to circulate through the Rideau navigation; but the compromise that resulted did not materially increase the cost of constructing the canal. Although the lock dimensions were increased to 33 feet by 134 feet, the depth of water remained the same, the expenditures required for dams and waste weirs were not altered, and even the amount of extra excavation required was minimal given the nature of the waterway. The cost of the lock masonry was definitely augmented, but probably no more than £1,000 per lock if not less, or a less than £50,000 increase in cost overall. (Lt. Col. By had calculated that it would have cost approximately £1,000 per lock more to construct the 50 foot wide lock than he recommended for construction on the Rideau Canal rather than the 20 foot wide lock; and this calculation was based on the amount of masonry required in the walls which was easily calculated. Moreover, it was the method by which the masonry contractors' work was measured and paid.)

Once the Rideau steamboat navigation was constructed, all of the military authorities, including the Duke of Wellington, were convinced that the military advantages conveyed by a steamboat navigation were worth the additional costs incurred in constructing the canal on a larger scale than originally intended. Far from disparaging the size of lock constructed by Lt. Col. By, the military authorities following the construction of the Rideau Canal pushed to have the three small 20 foot wide Grenville Canal locks, and the Lachine Canal locks, enlarged to complete the uninterrupted steamboat navigation from Quebec to Lake Ontario that Lt. Col. By had advocated be built. (The small batteaux lock erected at Vaudreuil in 1816 to pass the
rapids at the junction of the Ottawa and St. Lawrence rivers was rebuilt by a private company in 1832-33 on the enlarged scale of the Rideau Canal locks to complete the Ottawa canals system. The military were also anxious to have the Welland Canal enlarged, as Lt. Col. By had earlier advocated, so that it too could handle steamboats. Indeed, once Wellington's grand strategy of a static defence, based on strategically located permanent land fortifications, was abandoned as being unrealistic because of the prohibitive cost it entailed, if not because of its growing impracticability given the extended, open nature of the Canadian frontier and the improved communications both on land and sea enjoyed by the Americans, it was the existence of Lt. Col. By's Rideau Canal steamboat navigation that made possible the development of an alternative strategy of defence.

By the time of the Oregon crisis 1845-46, British defence planning had completed a gradual shift away from Wellington's extended static strategy of defence in favour of a mobile defence strategy relying on large well-equipped field forces to be moved and supported along relatively fast and secure lines of water communication by means of steamboats, more in keeping with Lt. Col. By's strategic outlook as enunciated in 1826-27. When Wellington devised his strategy for the defence of Canada in 1819, the vast forested area of Upper Canada and the American territories to the south of the Great Lakes were but sparsely settled, if at all, and linked one to another with very primitive roads or trails which were all but impassable for the heavy ordnance and troops of large army formations. In such circumstances, the invasion routes by which an American army could effectively attack Canada were few and clearly defined; and the objectives of any attack in force were equally few and obvious. Thus Wellington's strategy had emphasized the blocking up of the key invasion routes through the construction of large scale,
strategically sited, permanent fortifications to be
garrisoned by relatively small numbers of regular troops
supported by local militia units. The series of
fortifications was to be supplied and supported by a secure
interior system of water communications linking the various
fortifications one to another, and to the sea ports of
Quebec and Halifax, and ultimately, protected by British
naval supremacy on the high seas, with the factories,
military resources and arsenals of the mother country.
However, in subsequent years a virtual tide of immigrants
from Europe and the British Isles had swept into the
American territories south of the lakes and into Upper
Canada, clearing the land and opening relatively good roads
of communication through the hitherto impenetrable
wilderness. The Americans, in particular, developed
a complex network of canals, commencing with the completion
of the Erie barge canal in 1825, and railroads which
provided reliable communications links between the major
areas of population on the Atlantic Seaboard and the Great
Lakes as well as interconnecting with the major river
transport systems of the interior such as the Ohio and
Mississippi by 1840; and these transport systems in turn had
fostered the development of large centers of settlement on
the fringe of lakes Ontario and Erie. These
developments were foremost on the mind of General Lord
Cathcart, the new Commander of the Forces in Canada during
the Oregon crisis when he proceeded to work out a new
strategy for the defence of Canada incorporating the views
expressed in military reports that had been prepared at the
behest of his predecessor, Sir Richard Jackson.

Where the defence of Lower Canada (Canada East) was
concerned, Lord Cathcart continued to insist, as had the
Duke of Wellington and Major General Smyth, that the lines
of approach for American forces advancing towards Montreal
should be strongly defended and, in particular, that the
defences on St. Helen's Island and on Tête de pont at
Longueuil (the bridge crossing to Montreal Island from the south shore) should be strengthened. However, in keeping with the views of his subordinates, Cathcart was opposed to the construction of large scale permanent fortifications preferring instead the construction of modest field works and blockhouses supported by a large field army. Where the defence of Upper Canada (Canada West) was concerned, Cathcart questioned both the military utility of large scale permanent fortifications and the wisdom of abandoning control of the Great Lakes to the Americans in any future conflict. Not only could American forces by-pass any fortifications that might be constructed rather than suffering the hardships of conducting a series of protracted sieges, but any military position that might be taken up to protect the exposed frontier was vulnerable to being turned so long as the Americans enjoyed an uncontested naval supremacy on the Great Lakes. With no naval forces to oppose them, the Americans in any action against entrenched British forces were free to effect landings further along the coast and advance overland in force on the existing road networks to attack the British position in the rear while fixing the defending army with superior forces attacking from the front. Only naval forces operating in conjunction with the British forces on land could prevent or impede such a manoeuvre.  

If Upper Canada were to be successfully defended, in Cathcart's view, it was essential that the British should strive to secure command of the lakes on the outbreak of war, or at all hazards to at least establish a naval supremacy on Lake Ontario and place a respectable naval force on lakes Erie and Huron capable of protecting the coast from invasion or insult. Cathcart was well aware of the potential advantages enjoyed by the Americans in any struggle for naval supremacy on the lakes; but he calculated that these advantages could be neutralized in large part if immediately on the outbreak of war, the British forces were
fully prepared to take the offensive. The American forts, or harbours defences, were weakly garrisoned in peace time, and if combined naval and military assaults were launched against American harbours at the outbreak of war before the defences could be strengthened or the garrisons reinforced, the British forces would be able to capture or destroy the American vessels in harbour and dispose of their naval and military stores at the same time. Such actions would either paralyze or at least delay American offensive operations until such a time as "reinforcements of all descriptions" could arrive from England. Steamboats operating on the Canadian canals and waterways were, of course, counted on the move the troops, ordnance, military supplies, and no doubt naval supplies and guns, quickly inland from the sea ports of Quebec and Montreal, and to transport and protect the assault troops which were to descend on the American harbours on the outbreak of war.

The existence of the Rideau Canal as a steamboat navigation was a vital factor in any calculation involving the moving of troops, ordnance and supplies quickly into the Canadian interior; and Cathcart could only lament that the work on the Lachine Canal (which was being enlarged to accommodate steamboats) was not yet completed; and that the three small Grenville locks on the Ottawa River and the Welland Canal locks had not been enlarged so as to enable steamboats to circulate through them. Where operations on the lakes were concerned, Lord Cathcart recommended that the government should immediately establish the means for arming and equipping a sufficient number of steamboats, either paddle-wheelers or the new screw propelled type of vessels, to carry out the pre-emptive strikes to be launched on the outbreak of war. This, he added, could be done either by making preparations for the rapid arming of commercial steamers, or by constructing new steamers and/or schooners of such a size and description as could be readily converted into war vessels.
Although Lord Cathcart developed his strategy of defence from an analysis of the military situation, he arrived at a position very similar to that which Lord Stanley and Sir Robert Peel had arrived from assessing political/economic, and, to a far lesser extent, military considerations. They were in agreement, albeit for different reasons, that large scale permanent fortifications should not be constructed in Upper Canada; and that in any future war with the United States, Great Britain would have to build up a respectable naval force on the Great Lakes. Indeed, Lord Stanley's response to the problem presented by the launching of the U.S.S. Michigan and the prospect of a war breaking out over the Oregon boundary dispute (viz. the December 1845-January 1846 decision to have three steamboats, capable of being converted into war vessels, constructed at Kingston; to take an inventory of naval stores and ammunition stockpiled in Canada; and to strengthen the defences of the Kingston naval yard-Rideau Canal entrance against a naval attack) was a faint, but nonetheless positive, step in the direction of implementing the alternative defence strategy enunciated by Lord Cathcart when the military inadequacies, not to mention the prohibitive cost, of Wellington's defence strategy became obvious to the military. That alternative strategy of defence, however, was by no means a new formulation.

The mobile strategy of defence adopted by the British military in Canada ca. 1845, was in all of its ramifications, basically the strategy that Lt. Col. By had urged the ordnance to adopt for the defence of the Canadas in 1826-27. He had foreseen that it would be dependent for its viability on the facility and speed of transport that steamboats operating on the Great Lakes and the proposed Canadian canals would make possible. To that end, as related earlier, Lt. Col. By had recommended that the canals then under construction: the Rideau, the Ottawa canals, and the Welland Canal should be constructed with large locks
capable of accommodating the lake steamers; and that a large
tock navigation should be constructed to the rear of
Montreal Island to by-pass the small lock Lachine Canal.
Whatever the system of canals might have cost, Lt. Col. By
was convinced that it was by far the most economical and
effectual means of defending the Canadas (as it no doubt
would have been in that by making use of the Great Lakes it
negated the need for a system of costly interior canals
proposed to be constructed to the west of Kingston, and also
by relying on mobile field armies to meet any attack,
eliminated the need to construct a goodly number of the
large scale permanent fortifications required to implement
Wellington's static strategy of defence.) The key to By's
whole strategy, as to Lord Cathcart's formulation of a
similar strategy eighteen years later, was that steamboat
navigations would furnish the British forces with a mobility
superior to that enjoyed by the Americans on their side of
the lakes. Indeed, had the Rideau Canal been constructed
with locks 20 by 108 feet to pass the War of 1812 model
gunboats, propelled by oar and sail over the lakes and
drowned swamps of the Rideau waterway, the Americans on
their barge canals, newly-constructed roads, and nascent
local railways would have been far more mobile ca. 1845 than
the British forces operating in Canada. Moreover, Lt. Col.
By had also foreseen the need to place warships on the Great
Lakes; and realized that the best means of offsetting the
potential advantages enjoyed by the Americans was to adopt a
forward plan of attack to destroy American resources before
they could be effectively marshalled in strength for an
attack. Naval warships, operating on the Great Lakes as
well as steamboats armed and requisitioned for transport
duties, were essential to the carrying out of this strategy;
as well as for providing the means by which large field
armies could be quickly switched from one area to another to
meet any American invasion force mustering to attack Upper
Canada. Indeed, Lt. Col. By had not only proposed that
commercial steamboats should be armed and used for military transport and convoy duties on the outbreak of war; he advocated that the Rideau Canal should be constructed with the exceptionally large 150 by 50 foot locks (with ten, or as a workable compromise five, feet of water on the sills) which would have enabled the larger lake steamboats to circulate through the canal. Warships could have been constructed in the security of the Ottawa River at By Town and towed down the Rideau to Kingston for service on Lake Ontario, and then on other lakes if the Welland Canal were constructed with the large steamboat locks in keeping with his views. Although Lt. Col. By did not succeed in convincing the Ordnance that the Rideau Canal should be constructed with the large 150 by 50 foot lock with 5 feet of water on the sills (his matured preference), he did convince his superiors that it should be constructed as a steamboat navigation; and in so doing, he ensured that his strategy of a mobile defence would remain viable for the future. From a military point of view, the decision to construct the Rideau Canal with the 33 foot by 134 foot locks to serve as a steamboat navigation, rather than with the 20 foot by 108 foot locks as originally intended for the passage of gunboats, was by far the most critical decision taken in the course of British post-War of 1812 planning for the defence of Canada; and that decision was made owing to the foresight, exertions, and perseverance of Lt. Col. By. As the conduct of the Battle of the Windmill in 1838 showed, gunboats propelled by oar and sail were hopelessly inadequate in competition with steamboats where the movement of troops and ordnance was concerned; and they were totally obsolete in any war of movement requiring the rapid transfer of large armies and their field equipment over the great distances of the Upper Canadian frontier. Whatever the extra cost entailed in constructing the Rideau Canal as a steamboat navigation with the larger 33 by 134 foot locks, there is no denying that it was of inestimable value to the
military. It not only rendered Wellington's static strategy of defence, insofar as it was implemented, far more viable than it would otherwise have been; but it also, following the rejection of Wellington's grand strategy, enabled the military to adopt an alternative, more effective and far less costly, strategy of defence: viz. the long since forgotten mobile defence strategy that Lt. Col. By had enunciated almost two decades earlier in support of his argument that the Rideau Canal should be constructed as a large lock steamboat navigation.
Conclusion

Lt. Col. By was responsible for the Rideau Canal being constructed as a steamboat navigation with locks on a much larger scale than the structures that the Ordnance had originally instructed him to build. The Ordnance had directed that the locks of the Rideau Canal were to be built 20 feet wide by 108 feet long clear of the gates with a minimum of 4-1/2 feet of water on the sills, to match the locks on the Lachine Canal and the Grenville Canal then under construction, so as to enable gunboats to circulating freely from the lower St. Lawrence River through to Lake Ontario. However, after arriving at Montreal, Lt. Col. By became convinced on both military and commercial grounds that the Rideau Canal, and the other canals under construction in the Canadas, should be constructed on a much larger scale so that the largest of the river and lake steamboats coming into use could circulate through an uninterrupted steamboat navigation from Quebec to the head of Lake Superior. To that end, he forwarded a series of reports to the Ordnance explaining at length the military and economic advantages of a steamboat navigation and recommending that he be instructed to construct the Rideau Canal with locks 150 feet by 50 feet with 10 feet of water on the sills, and later, on more mature reflection, with locks of the same large dimensions but with only 5 feet of water on the sills. Finally, as a result of Lt. Col. By's efforts, the Kempt Committee in June 1828 decided that the Rideau Canal should be constructed as a steamboat navigation with locks 33 feet by 134 feet with 5 feet of water on the sills. Although Lt. Col. By's actions were initially little
appreciated by the Ordnance, there was nothing devious about his conduct. He made recommendations directly to his superiors, and thereafter submitted supportive arguments to elucidate the advantages to be gained if his recommendations were accepted.

It was no doubt highly irregular for an Officer once despatched to superintend an Ordnance project, to not only question the configuration and details of the proposed work, but even more so to bombard his superiors with reports advocating a major change in the scale of construction on the basis of arguments and assumptions which altered drastically the whole of the military strategy underlying the undertaking; and it is not surprising that the Master General of the Ordnance, the Duke of Wellington, was moved to declare: "I have never seen upon any subject such a performance as his last, in which he proposes so many alterations...." However, thereafter the Ordnance, under Wellington's successors the Marquis of Anglesey and then Lord Beresford, gave serious consideration to Lt. Col. By's arguments, and after a committee of engineers, the Bryce Committee, had examined By's plans and estimates and concluded that a steamboat navigation would provide significant military advantages if the government were willing to bear the added expense, both the Ordnance and the government of the day came to endorse the view that larger locks capable of passing steamboats should be constructed on the Rideau Canal. During the two years of correspondence leading up to the decision of the Kempt Committee in June 1828 that the Rideau Canal should be constructed with locks 33 feet by 134 feet with 5 feet of water on the sills to accommodate the smallest of the contemporary river steamboats, Lt. Col. By at no time sought to mislead the Ordnance or the government. To the contrary, he presented his arguments and opinions directly to his superiors; and while awaiting their decision, he pushed on diligently with the work under his direction in keeping with his
instructions even to the point of commencing the construction of three locks on the smaller gunboat scale of navigation. The scale of lock approved by the Kempt Committee was not as large as Lt. Col. By would have liked: but it was capable of passing the smallest of the river steamboats and so realized the essential part of By's argument: viz. that the Rideau Canal should be constructed as a steamboat navigation with a larger scale of lock than he had been instructed to build by the Ordnance on his appointment to superintend the construction of the Rideau Canal in March 1826.

The decision to construct the Rideau Canal with larger locks by no means constituted a victory for Lt. Col. By over the Duke of Wellington, the former Master General of the Ordnance, and/or over Major General Smyth, the framer of By's original instructions as to the size of canal to be constructed; and it was certainly not arrived at through the exercise of any guile, evasiveness, or even the advantage of good luck on the part of Lt. Col. By as has been alleged elsewhere. Initially, both the Duke of Wellington and Major General Smyth had objected to Lt. Col. By's recommendation that the Rideau Canal, and other canals then under construction in the Canadas, should be constructed as a steamboat navigation on technical grounds as well as because of the enormous cost of constructing all of the Canadian canals on the large scale envisaged by Lt. Col. By. But By was able to refute the technical arguments against employing steamboats on man-made canals by showing that Wellington and Smyth were under a misconception as to the nature of the Rideau waterway; and he managed to cut the cost of his proposed steamboat navigation through reducing the depth of the projected large lock to five feet and limiting its construction to the Rideau Canal section of the more extensive Quebec-Great Lakes steamboat navigation. In terms of military strategy, there was much to be said for constructing the Rideau Canal as a steamboat navigation as
the Bryce Committee had attested in their report of January 1828; and the Ordnance, at a very early date, had seen the military advantages to be derived from employing steamboats in logistical operations on a major river such as the St. Lawrence. But for technical reasons, the damage that the wake of the paddlewheels inflicted on canal banks and the prohibitive expense of existing methods of protecting canal banks, the Ordnance assumed that steamboats could not operate on canals. Hence, the elaborate system of interior canals that Wellington proposed to have constructed in Upper Canada were to be built exclusively as gunboat canals on a smaller scale than would have been required to pass the steamboats then in use. Once Lt. Col. By proved that steamboats could in fact operate on the Rideau navigation without damaging its banks, there remained only the question of whether the estimated additional cost of constructing larger locks was acceptable to the government, which concluded that it was.

With the possible exception of Major General Smyth, everyone concerned with the lock size question came to favour constructing the Rideau Canal with locks sufficiently large to accommodate steamboats. Indeed, the estimate for the larger 33 foot by 134 foot locks approved by the Kempt Committee, was submitted to Parliament in 1828 by a government of which Wellington was both Prime Minister and First Lord of the Treasury, and had he not then approved of the Rideau Canal being constructed as a steamboat navigation, and the additional expenditures required, the new plan and estimate would never have been accepted by the government let alone submitted to Parliament for approval. It is true that had Lt. Col. By not questioned his instructions, the Rideau Canal would have been built with the smaller 20 foot by 108 foot locks rather than the 33 foot by 134 foot locks actually constructed; but to condemn Lt. Col. By for the additional costs incurred as a result of the decision to construct the Rideau navigation with larger
locks is specious in view of how that decision evolved. Moreover, the final cost of the Rideau Canal construction project would not have been appreciably different had the lock size not been increased.

Generally in canal construction work the size of the locks to be constructed was the major determinant of the final cost of the project as it dictated the dimensions of the canal prism and consequently the amount of excavation work required on the whole of the canal. But the Rideau navigation, as distinct from conventional canals, consisted of large bodies of slackwater backed up by high dams rather than an excavated canal cut; and consequently, the construction of larger locks did not entail a great deal of additional excavation work as long as the depth of the canal was not increased. Indeed, compared to other cost factors, the extra excavation work required for the larger locks and on the several short canal cuts on the Rideau Canal was comparatively minimal. Lt. Col. By had calculated that even the large steamboat lock of 50 feet by 150 feet with 5 feet of water on the sills, would have added only about £1,127 per lock, or roughly £52,875 in total to the cost of the project for the masonry of the 47 locks; and this was a fixed cost which was readily calculable, and would have been somewhat less for the size of lock actually constructed. Whatever the size of lock adopted for construction on a slackwater navigation such as the Rideau Canal, the size and cost of the coffer dams, heavy dams, weirs, and embankments, required to construct the canal remained virtually the same for a navigation of five foot depth. (The larger steamboats that Lt. col. By wished to pass through his large 50 foot lock, however, might have entailed heavy expenditures in straightening the winding sections of the Cataraqui River where the movements of such vessels would otherwise have been severely restricted; but this was not necessary for the size of steamboat capable of passing the 33 foot wide lock and so its adoption did not entail such an expenditure.)
The unexpectedly heavy construction costs on that project were incurred as a result of the unforeseen necessity to construct waste weirs, the sickness factor which resulted in costly delays and the need to carry on expensive winter excavations, as well as the unexpectedly large amounts of difficult rock excavation encountered; and these factors were not affected in any large measure by the decision to construct the locks 33 feet by 134 feet rather than 20 feet by 108 feet. The locks were often constructed in the river bed where the extra 13 foot width of the lock was easily accommodated by leaving a wider gap in the adjacent dam being constructed across the river, and elsewhere many of the locks were positioned in snies or natural flood channels adjacent to the rapids where relatively little excavation work was required. Above the dams, of course, the whole river was backed up to form a series of stillwaters which were sufficiently wide to handle the 30 foot wide steamboats that the wider locks were designed to pass as well as the 16 foot wide gunboats that the 20 foot locks had formerly been intended to serve. Moreover, had Lt. Col. By simply followed his orders and constructed the Rideau navigation as a gunboat canal in keeping with the original plan of constructing the canal using cuts and locks, as proposed by Samuel Clowes and approved by the Ordnance, rather than dams and locks to overcome the various rapids, the cost of the rock excavation would have been astronomical. As it was Lt. Col. By through constructing a slackwater navigation managed to reduce the twenty-five miles of canal cuts, that would have had to be carried through solid rock at a significant depth in several sections to realize Clowes plan of construction on his recommended line of canal, to a total of less than 8-1/2 miles of relatively short canal cuts on an altered line of canal which took advantage of the terrain to reduce the amount of rock excavation to an absolute minimum where canal cuts were unavoidable. Given the views of Parliament on colonial defence expenditures, and those of
the Reform government which succeeded Wellington's administration in November 1830, the enormous costs that would have been incurred and the concomitant slow progress of the work in attempting to construct the Rideau navigation by the conventional means of canal cuts would probably have led to the project being abandoned at some point in an incomplete state and/or finished with roads being cut through the bush to provide at least the appearance but not the reality of a reliable military communication. Indeed, rather than Lt. Col. By being taken to task for increasing the cost of the canal through bringing about the decision to construct it with larger locks than originally intended, he should be regarded as the saviour of the project for coming up with the scheme of constructing a slackwater navigation using dams to flood out the rapids and eliminating the need for costly, time consuming canal cuts, and for pushing on the construction of the Rideau navigation with such an uncommon drive and determination which, in conjunction with the exercise of a superb managerial and planning effort, enabled him to exploit in full the advantages inherent in the contract system of work to complete in six years a project of such a magnitude as would in the normal course of construction have required twenty years to bring to a conclusion. On the Rideau Canal project, the heavy expenditures incurred were not the direct result of the decision to construct the canal with larger locks than originally intended; and but for Lt. Col. By's astute engineering decisions and efficiency in prosecuting the work, the costs would have been even greater, taking into account the sickness factor and the high cost of winter excavation work, if the canal had been built on the initial scale of construction in keeping with the approved plan of construction and the duration of other contemporary Ordnance and civil construction projects. Moreover, to compare the final cost of the Rideau Canal with the preliminary estimate for the project, and on the basis of that comparison to
deduce that Lt. Col. By was extravagant in his expenditures is absurd.

The £822,804 final cost of the Rideau Canal project does represent a five fold increase over the preliminary estimate of £169,000; but the latter figure is totally meaningless as a basis for assessing the magnitude of Lt. Col. By's cost overrun. The preliminary estimate, which Major General Carmichael Smyth prepared for the Rideau project from the general plan of construction and estimates contained in the survey report submitted to the Legislature of Upper Canada by Samuel Clowes, was questioned at the very inception of the project and subsequently rejected as being woefully inadequate. On his appointment to superintend the Rideau project, Lt. Col. By taking into account the length of the projected Rideau Canal, its wilderness location, and the differences of elevation to be overcome, as compared to what had been involved in constructing the Lachine Canal and the cost of that project, had informed Major General Smyth that the preliminary estimate was unrealistically low; and he had continued to express grave doubts as to its adequacy in the progress reports submitted subsequently to the Ordnance. When Lt. Col. By completed his preliminary survey of the canal route and prepared his initial plan of construction in the fall of 1827, he estimated that it would cost £474,844 to construct the Rideau Canal with 20 foot wide locks; and this estimate was accepted by the Ordnance after the Bryce Committee had examined into the great discrepancy between the two estimates. The Bryce Committee reported in January 1828 that Clowes' estimate was at best but a rough calculation of what he had conjectured would be the probable cost of such a canal rather than a detailed engineering estimate; and that Clowes' estimate, and in effect the preliminary estimate for the Rideau project based on that estimate, was woefully inadequate for the work in view. The subsequent decision to increase the size of the locks, from 20 feet by 108 feet to 33 feet by 134 feet,
necessitated a revised estimate for the project which Lt. Col. By submitted to the Kempt Committee in June 1828. This estimate in the amount of £576,757 was for the construction of the canal with the newly approved size of lock as well as for the support of the Rideau Canal establishment which Lt. Col. By had formerly been led to believe would be borne on the Army Extraordinaries; but both By and Col. Durnford, the Commanding Royal Engineer in Canada, repeatedly warned the Ordnance that the estimate might well have to be increased in view of the innumerable contingencies to which a project of the magnitude of the Rideau Canal was subject. The June 1828 estimate was in turn superseded by a supplementary estimate of £693,448 in March 1830 to cover a cost overrun of £30,848 on the 1828 estimate and the added cost of constructing waste weirs as it had become apparent that overflow dams were inadequate for controlling the heavy floods. Thereafter, the annual impact of a debilitating sickness and the difficult rock excavation encountered forced costs upwards necessitating an increase in the estimate in July 1831 to £719,074, and in February 1832 to £776,024. The final cost of the project was £822,804; but when an allowance is made for the cost of items, such as bridges, blockhouses, and payments made toward property damage claims which were not included in the earlier estimates, the true cost of constructing the canal proper was £763,146. Any assessment therefore of Lt. Col. By's competence as an engineer in estimating the cost of the Rideau Canal should be based not on a comparison between the preliminary estimate and the final cost of the whole project; but rather on a comparison between the estimate submitted to cover the size of canal and structures actually built and the costs incurred in doing so: viz. a comparison of the June 1828 estimate for the construction of the canal with the newly approved 33 foot wide locks with the £763,146 actual cost of constructing the works covered in that estimate less the £83,714 cost of the waste weirs. The need
for waste weirs had not been foreseen, or consequently included in the 1828 estimate; and in keeping with engineering practice the cost of the waste weirs cannot legitimately be considered a cost overrun on the estimate. Such a calculation yields an excess, or cost overrun, on By's June 1828 estimate for the works actually constructed of approximately 19.7 per cent. This figure is a far cry from the five fold cost overrun that Lt. Col. By has been accused of incurring on the Rideau Canal project; and it provides little grounds for either questioning Lt. Col. By's competence as an engineer or asserting that he was extravagant in his expenditures. This is all the more so when one takes into account the nature of the numerous reports that Lt. Col. By submitted to the Ordnance during the course of construction on the progress of the works and the costs being incurred; and the exhaustive examinations to which his plans, estimates, reports, and even the works progressing under his direction, were subjected by a series of committees appointed to examine into his engineering decisions and expenditures.

Both the committees of engineers, the Bryce Committee and the Kempt Committee appointed by the Ordnance to examine critically into Lt. Col. By's plans, estimates and expenditures, were highly laudatory of his engineering decisions and economizing measures as well as his personal zeal and exertion as evidenced in his conduct of the project. They commended By on the care and accuracy with which his surveys, reports, and contracts, had been prepared, and were unable to suggest any ways in which major savings might be realized. When subsequent increases in the estimates were required, the revised estimates were examined in detail by Col. Durnford at the insistence of the Ordnance; and he attested as to the absolute necessity of the extra costs incurred. At the same time, Lt. Col. By provided detailed progress reports bi-annually if not more frequently in which he delineated in exhaustive detail item
by item each of the expenditures made, the reasons for the same, and noted the excess or saving realized on the estimate for the item in question. Moreover, a Select Committee of the House of Commons in April 1831 and another in June 1832 examined Lt. Col. By's accounts in detail and did not question either his conduct of the construction project or the necessity of his expenditures. Even the Treasury Board, which was opposed to costly colonial defence projects and apparently bent on holding Lt. Col. By responsible for the large outlays on the Rideau Canal project, was unable to turn up any instance where Lt. Col. By had engaged in extravagant expenditures or mismanaged the project under his supervision. To the contrary, had the Treasury Board taken the time to compare the costs incurred in constructing the Rideau Canal, not to mention the peculiar difficulties that had to be surmounted in completing that enterprise, with other contemporary canal construction projects, or even with the cost of the several fortifications projects completed by the Ordnance, they would have found that there was much to be said for Lt. Col. By's assertion that he had constructed one of the finest canals in North America at a cost anywhere from 15 to 25 percent less than any comparable project; and that in so doing, he had accomplished in six years what in the normal course of construction would have taken 20 years to construct. But no such comparisons were in fact made.

The Ordnance had in hand numerous reports attesting to the magnitude of Lt. Col. By's achievement both in terms of what he had accomplished on the Rideau Canal project in the face of all but overwhelming difficulties; and how it compared to the cost and what had been accomplished on Ordnance projects elsewhere. The Master General and Board could have easily worked up a cost comparison with other contemporary canal construction projects to cast Lt. Col. By's efforts in a much better light than they were regarded by the Reform government and the Treasury Board. Indeed,
neither the 19.7 percent cost overrun on the June 1828 Rideau Canal estimate for the works actually constructed, nor the 42.6 percent total increase in expenditures over that estimate were by any means an excessive overrun when compared to what had transpired on other Ordnance construction projects or the cost overruns on several contemporary canal construction projects carried on under the direction of competent civil and military engineers. Significant cost overruns were experienced on almost all of the fortifications projects undertaken in keeping with Wellington's defence strategy, with one running as high as 238 percent (the Quebec Citadel) and another 52 percent (the Halifax Citadel) over the first engineering estimate for works; and in contrast to the Rideau Canal, the Ordnance projects undertaken were located for the most part near major sources of labour, food supplies and construction materials and on healthy sites of easy access where accurate levels and sections could be readily taken. Of the canals examined, the cost overruns on the first engineering estimate for the scale and configuration of canal actually constructed were as high as 87.6 percent on Telford's Caledonian Canal, 23 percent on Burnett's Lachine Canal, 55 percent on Geddes' Welland Canal, and 60 percent on the Ottawa canals constructed by the Royal Staff Corps; and the engineers on these works had faced nowhere near the flood problems, surveying complications, sickness and/or transportation-supply-communications difficulties that Lt. Col. By had had to overcome. Likewise, these canals were constructed on nowhere near as extensive a scale as the Rideau Canal; and yet the structures erected on at least two of the canals were not as well constructed or durable as those erected on the Rideau Canal despite their having taken, with the exception of the Lachine Canal, from 10 to 20 years to complete: viz. 10 years on the Welland Canal; 15 years on the Ottawa canals; and 20 years on the Caledonian Canal.
Most, if not all, of the information required to place Lt. Col. By's Rideau Canal efforts in a meaningful context was readily available in London and should have been taken into account by the Lords of the Treasury in the spring of 1832 when they not only questioned Lt. Col. By's competence on the grounds of his having submitted a series of ever increasingly higher estimates for the Rideau Canal project, but demanded his recall for expending monies on the Rideau in excess of the annual parliamentary grant of the previous year in contravention of existing financial regulations.

The various reports submitted to the Ordnance by Lt. Col. By, other senior Officers of Engineers, and both the Bryce and Kempt committees, had shown that there were valid reasons for the succession of augmentations in the Rideau project estimate none of which were a discredit to Lt. Col. By who, to the contrary, had succeeded by his personal exertions and ingenuity in keeping the costs from going even higher; and any review of Lt. Col. By's instructions and subsequent communications with the Board of Ordnance would have shown that he did not wilfully violate existing financial regulations. It was certainly not a case, as has been asserted elsewhere, of Lt. Col. By having taken advantage of the loose system of financial control and his relative isolation on the Rideau to evade spending limits imposed by the Imperial authorities.2

Where the Rideau Canal expenditures were concerned, Lt. Col. By was the victim of circumstances beyond his control which had their origin in the open ended contract system adopted to construct the canal and the loose, ill-defined, system of financial control which enabled the Ordnance to proceed with the work in the absence of any detailed plan or engineering estimate. Hitherto, major Ordnance construction projects were not commenced until a plan and engineering estimate for the work had been prepared and submitted to Parliament for approval together with a request for an appropriation to commence the work; and in subsequent years
annual appropriations were requested from Parliament in the Ordnance estimates until the project was completed. To carry out the work, the engineering establishment would hire a work force, on the day work system, at the commencement of each work season and keep it employed until the funds voted for that year were exhausted. In this manner, Parliament retained control over the inception of large scale construction projects and the sums to be expended thereafter. But on the Rideau project, Lt. Col. By was instructed to commence the construction work as soon as possible and to push it forward rapidly, consistent with a due regard for both economy and durability, while carrying on the survey work that was required to prepare the plans and estimate for the project; and the Ordnance, at the urging of Major General Smyth, decided to adopt the contract system of construction in preference to day work. The contract system had proved much more economical and expeditious than day work in constructing several civil canal construction projects; and Major General Smyth was convinced that it would facilitate the rapid construction of the Rideau Canal as well as provide a fixed termination date for its completion. The contracts, to be based on specifications drawn up by Lt. Col. By and let through competitive bids by the Commissariat Department, were to be for a fixed number of years; and to further speed the progress of construction the contractors were to be paid at a given rate per unit of work as the work advanced with no limitations placed on the amount to be paid out on a contract in any given year. Indeed, the Ordnance made it clear that it was prepared to accept disbursements in excess of the annual parliamentary grant being paid out of the Military Chest in any given year to avoid any need to curtail or hold back the work should the pace of construction outrun the monies granted; and the Colonial Department, on whose estimates the Rideau project was to be carried, agreed that the contracts should not be limited to
the amount of the annual parliamentary grant. The Ordnance in the instructions issued to Lt. Col. By for commencing the Rideau Canal project and the open ended contract system adopted for its construction, in effect evaded the controls that Parliament had hitherto exercised over the initiation of new projects, their projected cost, and the rate of expenditure.

The only inkling that Parliament had of the Ordnance's intention to proceed with the construction of the Rideau Canal was a request in the spring of 1826 for £5,000 towards the undertaking, which it was assumed was for a preliminary investigation of its cost and feasibility; and a second submission which followed in the spring of 1827, when £41,000 was requested to prosecute work on the Rideau Canal on the basis of £169,000 estimate for the project. Parliament, however, was not informed of either the nature of the contract system adopted for constructing the canal, the waiving of the customary limitation of the annual parliamentary grant on disbursements, or the fact that construction had proceeded without waiting for parliamentary approval of the engineering estimate still under preparation; nor that the estimate submitted for the project was the preliminary estimate which Lt. Col. By had already remonstrated against as being unrealistically low for constructing a navigation of the magnitude and complexity of the proposed Rideau Canal. Indeed, after completing an investigation of the Rideau project, a House of Commons Select Committee in April 1831 charged that the Ordnance without the consent of Parliament not only commenced work on the Rideau Canal project and authorized open ended contracts to be entered into which deprived the superintending engineer of any means of limiting his expenditures to the amount of the annual parliamentary grant, but deliberately submitted an unrealistically low preliminary estimate for the project with the intention of entrapping Parliament, once the estimate was approved and the work too far advanced
to be stopped without incurring a major loss, into paying for expenditures far in excess of anything that would have been approved had the true cost been known beforehand. The members had seen the Rideau Canal estimate increased from £169,000 in 1827, to £527,844 in 1828 (Lt. Col. By's £474,844 estimate for constructing the canal with 20 foot locks plus the estimated cost of enlarging the locks to accommodate the large lake steamboats), to the supplementary estimate of £693,449 accepted by Parliament in 1830; and, as attested by the Select Committee Report of April 1831, they had come to believe that the Ordnance had deliberately set out to present Parliament with a fait accompli entailing the expenditure of monies far beyond what they would otherwise have approved. Whether the preliminary estimate was submitted to Parliament in a deliberate effort to deceive as the Select Committee charged; or what appears more likely, it was a case of the Ordnance submitting a questionably low estimate in the hope that, despite Lt. Col. By's protests to the contrary, it would prove to be accurate, the ultimate result was a growing hostility toward the Rideau Canal project which boded ill for any further increases that might be required beyond the supplementary estimate of 1830. Indeed, there had always been a strong feeling Parliament against large expenditures on colonial defence projects; and the Ordnance had been fortunate in the first instances when major augmentations were required in the Rideau estimate that there was an administration in power, the Duke of Wellington's government, which was favourably disposed toward the project.

When Lt. Col. By's engineering estimate arrived in London in December 1827 setting forth that it would cost £474,844 to construct the Rideau Canal with 20 foot locks as opposed to the preliminary estimate of £169,000, the Ordnance immediately realized the awkward position it was in with Parliament having already approved the lesser estimate for the project. In an effort to retrieve the situation, it
was decided to appoint two committees composed of Officers of the Royal Engineers to examine into the plans and estimate submitted by Lt. Col. By, and Clowes' report and estimate on which the preliminary estimate had been based, as well as the works underway on the Rideau, to determine if the costs detailed in By's report could be reduced or the plans altered to bring the projected final cost in line with the preliminary estimate accepted by Parliament. At the same time, a work restraint order was despatched to Lt. Col. By to cease all work that did not require immediate execution; and the Ordnance decided, pending the completion of the enquiries to be undertaken, to limit the Rideau Canal expenditures in 1828 to £41,000 in keeping with the sum that Parliament was prepared to grant based on the preliminary estimate. But it soon became evident that Lt. Col. By had concluded all of the contracts required for the Rideau Canal works in keeping with his instructions to push on the construction as quickly as possible; and that he no longer possessed any freedom of action with respect to limiting his contractual obligations or his annual rate of expenditure. Moreover, the Bryce Committee report of 23 January 1828 rejected Clowes' estimate as totally inadequate and commended Lt. Col. By for having devised the best mode of constructing the canal at the least possible cost. The Ordnance in effect had trapped itself in a situation where it had either to submit a revised estimate to Parliament far beyond what had been previously approved and secure an increase in the amount of the annual grant to approximately £100,000 per annum to cover Lt. Col. By's projected disbursements under the contracts in force, or to act to have the project stopped with a dead loss of the monies expended to date and the government being placed in a position where it would be sued for breach of contract by the contractors. At this critical juncture, the Duke of Wellington formed a government; and the plight of the Ordnance received a more than sympathetic hearing.
On the basis of the Bryce Committee report of January 1828, the government of the Duke of Wellington accepted Lt. Col. By's estimate for the construction of the canal, and imposed a limit of £105,000 on his expenditures in 1828 as an interim measure sufficient to cover his projected costs pending the submission of the Kempt Committee report. The blame for the great discrepancy between the preliminary estimate and that of Lt. Col. By for constructing the Rideau Canal with 20 foot locks was placed directly on the inadequacies of Samuel Clowes' survey report; and the only subsequent hint of displeasure at Lt. Col. By's actions was Colonial Secretary Huskisson's expression of regret that By should have felt at liberty to proceed with the letting of the contracts after it had become apparent that the cost of the project would indeed far exceed the preliminary estimate. Lt. Col. By had acted strictly in keeping with his instruction to push on the work as quickly as possible; but in Huskisson's estimation Lt. Col. By should have requested further instructions from the Ordnance, in view of the large additional expenditures involved, before proceeding with the letting of the contracts. Otherwise Lt. Col. By's views and engineering decisions were so highly regarded that Huskisson, and in effect Wellington's government, were willing to accept the even higher expenditures required to construct the Rideau Canal with locks sufficiently large to pass the largest of the lake steamboats or whatever intermediate size of lock the Kempt Committee should determine would be best suited, with a due regard for economy, to realize the military and economic advantages a steamboat navigation would yield. The reports submitted by Lt. Col. By had made the advantages of a steamboat navigation so manifest to the government that Huskisson was willing to accept an expenditure of upwards of £597,676, the projected cost of the large 50 foot wide lock scale of canal, which represented more than double the
projected cost of any other major Ordnance construction project planned for the defence of North America.

In June 1828, the Kempt Committee determined that the Rideau Canal should be constructed with locks 33 feet by 134 feet and included Lt. Col. By's revised estimate of £576,757.14.9 1/2 for the newly approved scale of canal in their report; but the Committee in informing Lt. Col. By that his expenditures were to be limited to £105,000 in 1828, took no action to relieve him of any of his contracts or otherwise moved to enable him to exercise an element of control over his rate of expenditure. The Kempt Committee was well aware that the Rideau Canal contractors had refused to slow the progress of their work and had threatened to sue the government for breach of contract if forced to accept any modification in the terms of the contracts in force aimed at limiting their earnings in any given year; and Lt. Col. By had informed the Committee, as he had the Ordnance on numerous occasions, of the impossibility of arriving at any absolute or final cost figure for the Rideau Canal subject as it was to innumerable contingencies. As it turned out, Lt. Col. By's disbursements in 1828 did fall slightly below the limitation imposed by the government thereby averting a potential crisis; but a potentially embarrassing situation remained with the cost of the project being indeterminate and the rate of expenditure, tied as it was to the performance of the contractors, being beyond the control of the superintending engineer. The Ordnance, however, despite Lt. Col. By's misgivings, was fully cognizant of the situation in which he found himself; and when Lt. Col. By's expenditures in 1829 exceeded the parliamentary grant of that year and his projected costs ran in excess of the estimate accepted for the project, appropriate action was taken. Once satisfied that the additional costs incurred, or about to be incurred, were absolutely necessary, the Ordnance had managed to secure parliamentary approval for the Supplementary Estimate of
£693,449, submitted by Lt. Col. By in March 1830, as well as a concomitant increase in the amount of the annual parliamentary grant based on the new estimate to take care of the increased costs being incurred and cover off past expenditures in excess of the annual grant. With the exception of the unexpectedly heavy expenditures being incurred on the Rideau project, everything was proceeding as of 1830 as the Ordnance had anticipated when the contract system was adopted for the Rideau project. The construction work was progressing rapidly; and the Ordnance with the support of the government had been able to secure parliamentary approval for the supplementary estimate and the vote of the monies that were required to cover expenditures incurred previously in excess of the parliamentary grant. But in November 1830, a Reform government came to power which was opposed to large scale expenditures on colonial defence projects and bent on re-asserting parliamentary control over expenditures; and it was the failure of the Ordnance to come to grips with the exigencies of the new situation as it affected the Rideau project which ultimately exposed Lt. Col. By to the censure that he received.

The new financial regulations imposed by the Treasury Board over the objections of the Ordnance in July 1831, were specifically designed to prevent the Ordnance from evading Parliamentary control over spending and commencing projects in future in the same manner as the Rideau Canal project had been undertaken. To that end, the regulations stated that no new works were to be undertaken until a proper engineering estimate and plans were prepared, and no monies were to be voted until the plans and estimate were approved by Parliament. On multi-year projects, Parliament was to be informed each year of the sums voted to date, the obligations remaining to be fulfilled, and any additional works and deviations from the accepted plan that might be found necessary; and all contracts entered into were to
specify that payments were to be limited to the amount of the annual parliamentary grant for the project unless otherwise authorized by a Minute of Treasury Board to be conveyed directly to the House of Commons. Although the Ordnance was fully aware that the contract system long since in force on the Rideau project gave Lt. Col. By no control over his annual rate of expenditure, and had good reason to anticipate based on the on-going reports of Lt. Col. By and Col. Durnford that expenditures might well be incurred in excess of the annual grant for 1831, no action was taken. The Ordnance did not seek Treasury Board authorization, as provided for in the new financial regulations, for the Rideau Canal project expenditures to exceed the annual parliamentary grant in 1831 if required to carry on the canal work to a completion; and Lt. Col. By was not informed of the existence of the new regulations or even of the amount of the grant voted for 1831. The Ordnance, of course, knew that Lt. Col. By could not limit his expenditures unless he violated the terms of the contracts in force which would have resulted in lawsuits against the government for breach of contract and the suspension of work on the canal; but the Ordnance was definitely at fault for not seeking an exemption for the Rideau project from what, where the Rideau contracts were concerned, was after all an ex post facto regulation and should have been recognized as such no matter how hostile the Reform government might have been to such a request.

On the Rideau, Lt. Col. By was left in a situation where he not only had little if any control over his annual expenditures, but was still acting in keeping with his original orders to push on the construction of the canal as quickly as possible regardless of whether his expenditures exceeded the amount of the annual parliamentary grant or not. In previous years, he had informed the Ordnance at the commencement of the calendar year what his projected expenditures for the coming year would be so that the
Ordnance knew long before the monies were actually expended the approximate amount by which Lt. Col. By's expenditures would exceed the annual grant for the year based as it was on the estimate approved for the project at an earlier date. Once the Ordnance was convinced of the absolute necessity of the extra costs to be incurred, the estimate for the project had been increased and the amount of the annual grant likewise to meet the greater costs being incurred, although often the delays in communication necessitated the increase being made in the presentation of the succeeding year's estimates to Parliament after the excess had already been incurred on the annual grant. This was the system that had been followed on the Rideau Canal as costs, through no fault of Lt. Col. By, had continued to escalate. Therefore, when Lt. Col. By determined in the spring of 1831 that his expenditures for the coming work season which was supposed to be the final year of the project, would probably exceed the supplementary estimate by £25,624.3.4 and in effect the annual parliamentary grant based on that estimate by the same amount, he forwarded a report to that effect to Col. Durnford in Quebec so that the latter could check and verify By's statement as to the projected cost. But the Ordnance which received Lt. Col. By's report on 3 September 1831 followed in November by a report from Col. Durnford attesting to the absolute necessity of the additional expenditures, not only failed to warn Lt. Col. By that his projected expenditures would place him in violation of new financial regulations, if indeed it were not already too late for such a response, but did nothing to prepare the Treasury Board for that eventuality. Indeed the Ordnance, possibly in the vain hope that Lt. Col. By's actual expenditures would not exceed the amount of the annual grant for 1831, did not forward Lt. Col. By's report to the Treasury Board until 3 February 1832 much to the anger of the latter. Therefore, when Lt. Col. By's year end report arrived at the Ordnance, it was immediately forwarded to the
Treasury Board. That report showed that Lt. Col. By had expended a total of £715,408.15.6 to the close of the year 1831, an expenditure of £22,742.15.6 in excess of the annual grant for the year; and it included a statement to the effect that the project would have to be extended for an additional season, at a projected additional cost of £60,615.10.0, to finish off the work remaining to be done to complete the canal. At this point the Treasury Board lost all patience with the way in which the Rideau project was being conducted and issued their Minute of 25 May 1832 which questioned the competence of Lt. Col. By and demanded that he be recalled to face an investigation to determine why he had expended monies in excess of the annual grant in direct contravention of the existing financial regulations and why such an excess should have been incurred after repeated increases had been made in the original estimate submitted to Parliament.

In the subsequent investigation, the Treasury Board did not seek to determine whether the Ordnance had taken any steps to enable Lt. Col. By to comply with the new financial regulations or even whether he had been informed of their existence; and the ministers of the government made no effort to elucidate why the various increases were made in the estimate or assess to what extent they were justified. Certainly no effort was made to compare Lt. Col. By's disbursements on the Rideau Canal with what had been expended on other projects of a comparable nature. This was extremely unfortunate for Lt. Col. By, for though the investigation turned up no evidence either of extravagant expenditure or mismanagement, the Reform government continued to deny Lt. Col. By the honours he expected for his achievement on the Rideau in the belief that he was somehow responsible for the heavy expenditures incurred in its construction despite the ready availability of irrefutable evidence to the contrary; and the Ordnance for its part was unable to come effectively to Lt. Col. By's
defence without bringing the wrath of the Treasury Board down upon itself for what had transpired.

Sir James Kempt, the Master General of the Ordnance, did what he could to explain to the ministers of the government why Lt. Col. By had no control over his annual expenditures; but the ministers were not prepared to undertake a further investigation into the matter. Nonetheless, the Ordnance to its credit did not desert Lt. Col. By and resisted whatever temptation there might have been to make him the scapegoat for the financial problems encountered on the Rideau Canal project.

Lt. Col. By had constructed a magnificent steamboat navigation in a remarkably short period of time under the most trying of circumstances, and at a cost significantly lower in view of what had been constructed than any comparable canal in Canada; and yet the government of the day was oblivious to this accomplishment as it concentrated its displeasure on the magnitude of the sum expended, some £777,146 at the completion of the project on 31 August 1832 which increased ultimately to £822,804 thereafter following the payment of all outstanding property damage claims. Rather than investigating Lt. Col. By's activities, estimates, and expenditures in detail to determine what had transpired on the preliminary and initial engineering estimates, the government concentrated its efforts on placing financial restraints on other Ordnance projects to preclude similar developments elsewhere. Although there was a good deal of information in hand at the Ordnance attesting to the efficiency with which Lt. Col. By had conducted the Rideau Canal project under the most trying of difficulties, and Treasury Board was made aware that the censure levelled at Lt. Col. By in May 1832 for expending monies in excess of the 1831 parliamentary grant contrary to government regulations was unwarranted, no public statement was ever made in defence of Lt. Col. By. To the contrary, the Select Parliamentary Committee report of 29 June 1832 remained on
record in which the committee members had accused Lt. Col. By of submitting totally unreliable estimates for the Rideau Canal project and expressed their surprise that he expended monies in excess of the 1831 parliamentary grant in contravention of the July 1831 financial regulations. In effect, the subsequent investigations, such as they were, exonerated Lt. Col. By of any wrongdoing or charge of incompetence; but he was right in realizing that this was an insufficient vindication in view of the charges that had been made against him, not to mention a rather poor reward for the service he had rendered on the Rideau. Hence his request of the Ordnance that:

I may be honored with some public distinction as will show that my character as a soldier is without stain, and that I have not lost the confidence or good opinion of my Government.4

The failure of the government to launch a thorough investigation into the Rideau Canal estimates and expenditures and the way in which that project was conducted, coupled with the inability of the Ordnance to obtain any public recognition for Lt. Col. By's achievements on the Rideau, has served to obscure the whole question of whether By was indeed responsible for incurring the heavy Rideau Canal expenditures which Parliament had to make good thereafter. At least one recent critic has taken Lt. Col. By to task for the five fold increase in the final cost of the Rideau Canal over the preliminary estimate accepted by Parliament for the project, and has held Lt. Col. By responsible for entrapping Parliament into paying out much more for the construction of the Rideau Canal than it had ever intended should be spent.5

The present study of Lt. Col. By's instructions and the on-going developments during the construction of the Rideau Canal makes it clear that the "man on the spot", Lt. Col. By, was not responsible for the heavy expenditures incurred
on the Rideau project; and he certainly did not blatantly exploit his position to evade the limits placed on his expenditures, or spend unjustifiably excessive amounts of money in constructing a canal at supposedly a much greater cost and on a larger scale than his superiors would have accepted had they been well informed of what he was doing. To the contrary, the expenditures were made to construct an approved scale of canal in the face of obstacles of so difficult a nature as to require such an outlay, if not more; and it was the Ordnance, in an era when large scale expenditures on colonial defence projects were not looked on favourably by Parliament, which through exploiting the loose, ill-defined, system of financial control had embarked on a major construction project without the prior consent of Parliament, and in effect placed Parliament in a position where it had little choice but to pay for the substantial costs incurred. Insofar as anyone was responsible, or culpable, for the course of developments culminating in Lt. Col. By's recall, and the subsequent imposition of severe financial restraints on other Colonial defence projects, it was the Board of Ordnance.

Although the Treasury Board, in response to what had transpired on the Rideau project, placed severe restraints on spending which prevented the completion of the Ottawa canals on the enlarged scale of the Rideau steamboat navigation, this by no means meant that the monies expended in constructing the Rideau Canal with the larger locks were wasted. The three small 20 foot wide locks at Grenville did prevent the passage of river steamboats, the smallest of which were approximately 30 feet wide across the paddleboxes; but the absence of an uninterrupted steamboat navigation on the Ottawa River did not adversely affect the existing mode of river transport or negate the real advantages that the larger 33 foot wide locks bestowed on the Rideau navigation. All freight forwarded by water, was transported at that time in Durham boats and barges which
were often towed by steamboats; and the former could pass through the small locks at Grenville. Consequently no transhipment was required and virtually no time was lost in passage as steamboats were stationed on the river above and below the three short Ottawa canals to tow the freight boats; and the steamboats used to tow the freight boats on the Rideau Canal were able to pass through the whole system. This is not to say, however, that the Rideau Canal could have functioned as an effective steam boat navigation had it been built with the small 20 foot wide locks. The large number of locksites on the Rideau Canal, 22 in all, precluded the stationing of steamboats on each stretch of the river canal between them. Steamboats could have been placed on the several lakes and/or major river sections of the Rideau; but elsewhere on the numerous sections of the canal the passage of the Durham boats and barges would have been greatly impeded and the speed of passage, as the Ordnance realized once Lt. Col. By explained the nature of the waterway, would have been too slow and unreliable to meet military requirements.

From a military point of view, there was never any doubt as to the substantial advantages that Lt. Col. By had gained for the Ordnance in bringing about, through his personal initiative and efforts, the construction of the Rideau Canal on the scale of a steamboat navigation. Where speed of movement was essential, gunboats and Durham boats propelled by oars and sail, or setting poles and sail respectively, were of questionable utility as they could be held for days, even weeks, on the Rideau lakes waiting for favourable winds and in the absence of towpaths even the passage of the river sections would not have been all that rapid. The speed and certainty of passage could have been improved if towpaths were available; but as Lt. Col. By had pointed out, they would have been horrendously expensive to construct on the rivers because of the nature of the banks and would have been exposed to heavy ice and flood damage
necessitating extensive and expensive repairs each spring. Moreover, if towpaths had been built around the margins of the lakes, they would have added greatly to the distance to be traversed. All of these potential problems, however, had been eliminated by the decision to construct an uninterrupted steamboat navigation. Lt. Col. By calculated that troops, ordnance and supplies could be moved from Quebec to Kingston in 77 hours via the Ottawa-Rideau system making use of steam tow boats on the lower St. Lawrence, the two lengthy sections of the Ottawa River and on the whole of the Rideau system; and this speed of transit could be counted on whenever troops, ordnance and supplies had to be moved quickly to the defence of Upper Canada. To take full advantage of the speed and manoeuvrability of steamboats, Lt. Col. By had counted on the gunboats, which had hitherto transported troops and convoyed the freight boats required to supply the army in the field, being replaced by commercial steamboats manned and armed by the Royal Navy at the outbreak of war; and after the Battle of the Windmill in November 1838, it was obvious that gunboats propelled by oars and sail were all but obsolete. Steamboats established themselves as the military transport vessels of the future; and the military came to depend heavily on the Rideau Canal in its capacity as a steamboat navigation to provide both the speed and certainty of transit which were critical to the viability of their plan for the defence of Upper Canada.

When the British military planners realized that the system of interior canals and permanent fortifications required to implement Wellington's strategy of a static defence were prohibitively expensive to construct, and in the changed circumstances of the 1840s were quite inadequate for the defence of Canada, the existence of a steamboat navigation on the Rideau route made possible the development of an alternative strategy of a mobile defence. The new strategy, in which the speed of transit provided by
steamboats employed on the Rideau Canal was a critical element, was basically that devised by Lt. Col. By in 1826-27 in support of his argument in favour of constructing the Rideau Canal as a steamboat navigation. In keeping with the new strategy, large numbers of troops were to be marshalled in Canada, on the outbreak of war, and moved quickly to meet any invasion threat on the frontier. The speed of movement and flexibility required to render this strategy effective, as well as the transport system required to supply a large mobile army in the field, was to be provided, as Lt. Col. By had foreseen, by commercial steamboats which were to be armed and employed on the Great Lakes, Rideau-Ottawa, St. Lawrence waterways.

Although Lt. Col. By had anticipated that the Rideau Canal, if constructed as part of an uninterrupted steamboat navigation stretching from Quebec to Lake Ontario and eventually via the Welland Canal to the upper Great Lakes, would capture the trade of the Canadian and American interior for the St. Lawrence and ensure that the preponderance of the steamboats operating on the lakes would be of British registry and available for war service, this did not prove to be the case. The Rideau Canal, of course, was not constructed on as large a scale as Lt. Col. By would have liked to enable the large lake steam boats to pass unimpeded through the whole system; but the competing routes still possessed significant advantages over the Rideau regardless of the size of the locks. The Rideau Canal did become an important commercial import trade-immigration route following its completion, but the bulk of the down trade continued to resort to the unimproved though more direct St. Lawrence River route. Thereafter, the construction of the St. Lawrence canal system ca. 1848 deprived the Rideau Canal of most of the through trade; although the former continued to play a key role in the local import-export trade of the Rideau Corridor. In this respect, Lt. Col. By clearly miscalculated the economic
potential of the Rideau Canal; but he was not the only one to expect great things of an uninterrupted steamboat navigation intended to funnel the trade of the American mid-west down the St. Lawrence through Montreal. Even the St. Lawrence Canals, although they provided a cheaper, more convenient, shipping system than the Erie barge canal, were unable to overcome the advantages possessed by that canal in terminating in the port of New York. As a result, the Americans came to have the preponderance of steamboats on every lake but Lake Ontario; but the latter was the key strategic lake on which the defence of Upper Canada depended. In the absence of the Duke of Wellington's proposed network of interior canals in Upper Canada, which were beyond realization because of their potential cost of construction, the only viable means of defending the province was by moving troops, ordnance and supplies, to the western frontier from Kingston along Lake Ontario. So long as the British were able to retain a respectable force of steamboats in being on Lake Ontario and maintain the Rideau Canal in operation as an uninterrupted steamboat navigation, it was possible in the changed circumstances of the 1840s to envisage a successful defence of Upper Canada being undertaken. As to Lt. Col. By's role in bringing about the construction of the Rideau Canal as a steamboat navigation, and the importance of his achievement to the Ordnance, perhaps the best testimonial is a remark made by the Duke of Wellington, during the course of the Ordnance's 1841 reappraisal of its Canadian defence plans, to the effect that: "However expensive the works upon the Rideau, nobody now doubts the wisdom of the plan, its efficacy, and above all, its economy."7

In retrospect, it is evident that Lt. Col. By was a military strategist of exceptional foresight and judgment who had realized long before his superior Officers that whatever the added cost of constructing the Rideau Canal with larger locks to serve as a steamboat navigation might
be, it was a far cheaper and more effective means of strengthening the defences of Upper Canada, in conjunction with deployment of a large field force in time of war, than the alternative with the large scale permanent fortifications required to complete Wellington's static strategy of defence.

Contrary to what had been argued elsewhere, Lt. Col. By did not in the pursuit of personal "empire-building plans" or otherwise, dupe the British government into constructing larger locks than planned; and the substantial amount of money expended on the Rideau steamboat navigation was by no means a direct result of the decision to construct larger locks or attributable to any extravagance on Lt. Col. By's part. If anyone was guilty of formulating grandiose plans and resorting to subterfuge to entrap the government into large scale expenditures, it was the Master General and the Board of Ordnance in the manner in which work was undertaken on the Rideau project, and earlier the Ottawa canals, as an integral part of a broader effort, which unbeknownst to Parliament, was intended to culminate in the construction of all of the structures required to carry out Wellington's grand strategy for the defence of the Canada. It was highly unlikely that Parliament would have authorized construction work to proceed on the Rideau Canal in the period 1826-27 if the members had had any idea that it would cost a minimum of £474,844 to construct on the scale of a gunboat canal with locks 20 by 108 feet, let alone the more than £822,000 actually expended in constructing the canal as a steamboat navigation with 33 by 134 foot locks. Had the Ordnance not mislead Parliament in 1827, whether inadvertently or otherwise, with the unrealistically low £169,000 estimate for the project, the Rideau Canal would probably never have been constructed; and Upper Canada would have remained virtually indefensible.

The sequence of events makes it clear that the defeat of Wellington's grand stratagy was not the direct result of
the heavy expenditures Lt. Col. By incurred on the Rideau project. From the very inception of Wellington's defence scheme, it was apparent even to the Ordnance that the projected cost was far beyond anything Parliament could ever be brought to approve; and yet the Ordnance adopted Wellington's plan and strove to secure government support for its implementation. Major General Smyth had calculated in his report of 9 September 1825, that it would cost £1,686,944 to construct all of the permanent fortifications together with two of the gunboat canals (the Rideau and the Ottawa canals) required to implement Wellington's strategy; and this did not include any estimate of the cost of the proposed network of gunboat canals to be constructed in the interior of Upper Canada to complete the scheme. In view of the projected cost, successive governments had refused to countenance the submission of such a scheme to Parliament, although relatively small sums were requested and voted to enable several works which had been approved earlier to be continued (viz. the Ottawa canals, the fort at Isle aux Noix, and the Quebec Citadel) and for preliminary work to be undertaken to prepare plans and an estimate, or so Parliament supposed, for two projects (viz. the Rideau Canal, and the Kingston fortifications) without the members being made aware that these projects were but a small part of a much larger scheme or in several cases, being informed of the estimated cost of the individual project. Indeed, if the Duke of Wellington had not had the good fortune to form a ministry in January 1828, his scheme of defence for the Canadas would probably have been pigeon-holed in keeping with the fate of other military planning exercises; and this was especially so as in the winter of 1827-28, when the engineering estimates arrived at the Ordnance, it was found that the preliminary estimate of Major General Smyth for the overall cost of the defence project would have to be increased from £1,686,944 to £2,335,544 or more.
With the support of Wellington's government, the Ordnance proceeded in the spring of 1828 to inform Parliament of the magnitude of the defence project underway; but to render the projected cost more palatable, it was decided in the first instance to postpone indefinitely roughly two-thirds of the contemplated fortifications projects. In effect, Parliament was requested to approve one-third of the scheme for construction of an estimated cost of £798,215 which did not include the cost of the two canals under construction; and the Ordnance explained that the fortifications works to be undertaken would probably cost, allowing for various contingencies, upwards of £900,000 spread over six years. After an acrimonious debate Parliament proved willing to acquiesce in the upward revision of the estimates for the several Ordnance construction projects already underway, including the Rideau Canal, but refused to approve any of the new works proposed by the Ordnance. Thereafter, Wellington's government managed, in a compromise effected in July 1828, to secure Parliamentary approval for the undertaking of two new works, the Halifax Citadel and the Kingston fortifications in return for the government agreeing to drop the remaining defence projects. At the same time, Parliament agreed only to provide funds for the first of the six redoubts planned for the Kingston defences, and insisted that further funds for that project had to be requested on a separate estimate to be submitted to Parliament for approval for each redoubt in turn prior to the commencement of its construction. Here then was the defeat of Wellington's grand strategy for the defence of the Canadas long before the Treasury Board became aware of the ultimate cost of the Rideau Canal project; and it was attributable to the projected heavy cost of the works required to implement Wellington's scheme and the unwillingness of Parliament to countenance such heavy expenditures on a colonial defence project rather than the actual, or projected cost, of the Rideau Canal per se. Not
only was Wellington's defence scheme defeated to all intents and purposes in 1828, if indeed it was ever a viable undertaking given the prevailing attitude of Parliament; but the acrimonious debate that it occasioned in Parliament on its initial presentation in a drastically curtailed form, and the views expressed by the Reformers during the debate, made it clear that should the latter come to power, as they did in November 1830, any increase in the estimates beyond what had been approved by Parliament, or any excess of expenditure over the estimate or the annual grant voted on the basis of that estimate, would come under a severe attack; and this was doubly so following the imposition of the new financial regulations in July 1831. With the exception of the Kingston fortifications project, which was terminated by the Treasury after the completion of the first of six projected redoubts, all of the handful of construction projects undertaken by the Ordnance in an effort aimed at ultimately implementing Wellington's grand strategy of defence for the Canadas, eventually ran over the estimates approved by Parliament, some by a wide margin, but they were constructed on either the day-work, or a limited contract, system where the superintending engineer was able to keep his expenditures within the annual grant pending further increases in the estimate. Hence the additional costs incurred were spread out over a goodly number of years. It was Lt. Col. By's misfortune that his energetic efforts to complete the canal as quickly as possible in keeping with his orders resulted in a cost overrun being incurred directly following the imposition of the new financial regulations; and through no fault of his own, he ran afoul of them in seeming defiance of a Treasury Board which was bent on showing the Ordnance that expenditures in excess of what had been approved by Parliament were no longer to be tolerated. As a result, he was censured by the Treasury Board, recalled to face an investigation, and ultimately denied the honours that the Ordnance felt he so
deservedly merited. In effect, Lt. Col. By was a victim of circumstances and bore the brunt of Treasury Board's displeasure for developments over which he had no control and which were rooted in, if not the predictable outcome of, the past practices of the Ordnance in its dealings with Parliament.

In all of his dealings with the Ordnance, Lt. Col. By was scrupulously correct and forthright. He did not act contrary to orders at any time nor engage in an effort to deceive the Ordnance for whatever reason. To the contrary, his reports were models for their day in detailing the progress of construction. Therein he strove always to present as accurate an estimate of the potential cost of the canal as possible under the circumstances, together with an estimate of his projected rate of expenditure in the coming year. The reports included an itemized account of his expenditures to date, and an explanation for any alterations required in the plans approved by the Kempt Committee and for the extra costs incurred, or savings realized, on each item of the initial estimate for the scale of canal being constructed. Moreover, on numerous occasions, Lt. Col. By had informed the Ordnance that the great number of contingencies to which a project of the magnitude of the Rideau Canal was subject prevented his preparing an absolute or final estimate for the project while construction proceeded; and he had repeatedly pointed out that the contract system in force deprived him of any real control over his annual rate of expenditure. In his engineering decisions, Lt. Col. By proved to be a highly competent and imaginative engineer, but what is more he was a superintending engineer whose achievements, taking into account the magnitude of the project, the peculiar difficulties overcome, the speed and quality of construction, were such as to place him on a par with the contemporary canal engineers who were pre-eminent in their field.
In strictly military concerns, he proved to be far in advance of his contemporaries in realizing how thoroughly the introduction of steamboats would transform warfare on the large inland lakes and rivers of the Canadian/American frontier, and in seeing the strategic possibilities, and feasibility, of employing steamboats on the canals being constructed in the Canadas. Had the Rideau Canal not been completed or had it been constructed as a small gunboat canal, the whole of the Ordnance's effort at engineering the defence of the Canadas would have been naught insofar as Upper Canada was concerned; but that it was completed as a steamboat navigation was due as much to the zeal, superior initiative and abilities of Lt. Col. By in his capacity as superintending engineer as it was a result of his foresight and assertiveness in striving to convince the Ordnance that the Rideau Canal should be constructed as a steamboat navigation.

Although Lt. Col. By was able to convince the Master General and Board of Ordnance, as well as Secretary Huskisson, that the Rideau Canal should be constructed as a steamboat navigation, and a number of different size locks were proposed to pass one or other of the various classes of steamboats in service on the rivers and lakes of the Canadas, the dimensions of the locks that By initially proposed to construct in response to the Kempt Committee's report of 28 June 1828, were totally out of keeping with the hull design of any of the contemporary steamboats. The 134 by 33 foot lock chamber proposed by him was a bastard size where steamboats were concerned, and was much longer than the Kempt Committee had intended it to be, or indeed, in retrospect, than it needed to be.

The contemporary lake steamers that Lt. Col. By wished to accommodate with his proposed 150 by 50 foot lock with 10 feet of water on the sills, were, with but few exceptions, 110 to 130 feet long, 40 to 50 feet in breadth, and drew 8 feet of water when fully loaded. With a lightened load, they could pass a lock 150 by 50 feet with a minimum of 5 feet of water on the sills, and hence By's second lock size proposal. The river steamboats in use on the Ottawa River, as well as the smaller of the steamboats plying the St. Lawrence River, were approximately 108 feet long and 30 feet wide across the paddle boxes and drew from 3\(\frac{1}{2}\) to 4 feet of water; and the instructions the Kempt Committee gave to Lt. Col. By stated that the Rideau Canal was to be 5 feet deep
with locks capable of passing steamboats of that size. In
the actual report of the Kempt Committee, it was pointed out
that such a lock would be sufficient to pass a timber crib
(25 feet wide by less than 100 feet long), two Durham boats
at a time (length 60 feet with a 9 to 13½ foot beam), or
spars up to 108 feet long. But the report, which Sir James
Kempt let Lt. Col. By peruse before the former departed from
Kingston,¹ was worded in part to the effect that:

the Committee recommend that the whole Back
Water Communication [the Rideau and Ottawa
River canals] should be completed with 5 feet
depth; and the locks uniformly adopted for the
passage of steamboats 30 feet wide over the
paddle boxes, and for spars 108 feet long,
besides ample space for working the
gates.²

Lt. Col. By had seized on this wording, and submitted a plan
for a lock 33 feet wide, as required for the size of steam­
boat in contemplation, but 134 feet long in the chamber to
enable the longest spars then being exported, some 130 feet
long, to pass the locks. The width and depth of the
proposed lock was in keeping with the overall breadth and
draught of the size of steamboat that the canal was intended
to accommodate; but the length of the lock chamber bore no
relation to all to the corresponding dimension of the
steamboat. Lt. Colonel Fanshawe, who had kept in contact
with Lt. Col. By following Sir James Kempt's departure for
Halifax immediately upon completion of the Kempt Committee's
report, protested to Lt. Col. By over the lack of uniformity
in the dimensions of the proposed 134 by 33 foot lock with
respect to the size of vessels intended to operate on the
canal.³ Thereafter, as shown by all subsequent drawings
and the locks actually constructed, the length of the lock
chamber was reduced. Instead of being 134 feet long in the
chamber, measured from the point of the lower sill to the
face of the breastwall (144 feet measured from point of
lower sill to point of upper sill), the lock was made 124 feet long in the chamber (134 feet long from point of sill to point of sill). Allowing the 13 feet clearance required to swing the lower gates, such a lock chamber had a clear length of 111 feet;\(^4\) and it could pass a vessel of a maximum size of 110 feet by 31½ feet.\(^5\) This, of course, was directly in keeping with the Kempt Committee decision of 28 June 1828 that the new steamboat lock should be capable of passing small river steamboats 108 feet long by 30 feet wide clear of the paddles, as well as spars up to 108 feet long.\(^6\) However, as steamboats evolved on the Rideau down through the years, the locks came to be regarded as being ill-proportioned, and were indeed out of keeping with the hull dimensions of the latter day steamboats.

In 1866, an engineer who had studied the commercial traffic on the Rideau Canal, reported that the length of the Rideau Canal locks was "quite out of proportion" to their width and to the steamboats and barges plying the canal; and that in view of the number of short turns in the waterway, the size of vessel best suited to the Rideau system was generally believed to be one not exceeding 110 feet in length and roughly 23 feet in width.\(^7\) Both of these conclusions are borne out by the size of vessels employed on the Rideau Canal throughout its commercial life, 1832-ca. 1935.

The early side paddle wheelers which towed the Durham boats and timber rafts on the Rideau Canal (such as the Union which had formerly been employed exclusively on the Grenville-Hull run on the Ottawa River), were roughly 30 feet wide over the paddle boxes and 108 feet long as attested to by the Kempt Committee;\(^8\) and the barges, which at a relatively early date superseded the Durham boats as the principal freight carriers on the Rideau, were less than 100 feet long by 20 feet wide.\(^9\) The steam tugs introduced on the Rideau Canal ca. 1856, were, with but one exception, a maximum of 56 feet in length and 13 feet in
beam,\textsuperscript{10} and the steam passenger boats that entered into service about the same time, were no more than 100 feet in length.\textsuperscript{11} Moreover, the largest class of steamers to ply the Rideau Canal, the passenger-excursion steamers, such as the James Swift (renamed the Rideau King) and the Rideau Queen which were in service ca. 1890-1935, were approximately 108 feet long by 24 feet in breadth.\textsuperscript{12} Initially, the 33 foot wide lock was required to clear the paddle boxes of the side-wheelers which added as much as 6 feet to the breadth of hull of the contemporary river steamboats;\textsuperscript{13} but with the exception of several experiments, little effort appears to have been made to maximize the breadth of hull of the Rideau Canal steamers even long after sidewheelers ceased to be built.

The first steamboat to be designed and built specifically for service on the Rideau Canal, the John By, launched at Kingston in December 1831, was 110 feet long with a 26 foot beam. It was built by Robert Drummond, one of the contractors on the Rideau Canal construction project,\textsuperscript{14} and was built as a sternwheeler possibly to gain a wide breadth of hull and obtain more usable cargo space in keeping with Lt. Col. By’s earlier inquiries along that line.\textsuperscript{15} But whatever the advantages to be gained over a sidewheeler, the width of the John By did not approach the width of the lock; and the handling qualities were so poor that it appears to have discouraged further experiments with sternwheelers on the Rideau Canal.\textsuperscript{16} Although sternwheelers proliferated on the western rivers of Canada and the United Stated in the late 19th century once structural problems associated with the building of sternwheelers were eliminated by technological advances in hull designs,\textsuperscript{17} they were not introduced on the Rideau Canal.\textsuperscript{18} The only other effort that is known to have been made to maximize the breadth of hull of a Rideau Canal steamboat, was with the sidewheeler Beaver launched at Kingston in 1840. It was designed for service on the Rideau
Canal; and the side paddle wheels were set into a fiddle-shaped hull to enable the hull width to be increased proportionately. However, the hull was only 17 feet in breadth by 104 feet long,\textsuperscript{19} and as such by no means took full advantage of the width of the Rideau Canal locks. This development also does not appear to have been followed up; and even the introduction of the screw propeller during the 1840s did not result in the building of wider hulls to take advantage of the increased clearance in the locks afforded by the elimination of the side paddle wheels.\textsuperscript{20}

In view of the evolution of steamboats on the Rideau Canal, it is clear that the configuration of the river-canal channel did indeed impose limitations on the size of Rideau Canal steamboats regardless of the size of lock built. The extra length that Lt. Col. By wished to add to the dimensions of the lock preferred by the Kempt Committee would have resulted in a bastard lock ill-proportioned for steamboats. Whatever its value in being able to pass the longest of the spars destined for the Royal Navy, it is certain that in terms of the vessels employed on ply the canal, the added length was superfluous. Indeed, without resorting to a great deal of expense to straighten the course of several of the river sections of the Rideau Canal (and the lower Cataraqui River section in particular), the breadth of steamboats could not have been increased to take full advantage of the 33 foot wide lock actually constructed, nor on the other hand, could steamers have been lengthened to take advantage of a longer chamber had the locks been constructed in keeping with the plans By had initially prepared in response to the Kempt Committee's decision.\textsuperscript{21}

Nonetheless in all fairness to Lt. Col. By, it should be pointed out that the sticks of timber intended to be used for Royal Navy spars, which in their rough hewn state were as long as 120 to 130 feet, would not have passed a lock 108 feet long. If the Rideau Canal were to be constructed with
locks 33 feet wide by 108 feet long clear of the gates, in keeping with the recommendation of the Kempt Committee, these sticks of timber when cut in the Rideau lakes area would have had to be hauled overland around the locksites; and this was no easy task at the best of times. In their finished state, the largest sized spars used by the Royal Navy were masts of 35 inches diameter, 110 feet long; yards of 26 inches diameter, 116 feet long; and bowsprits of 38 inches diameter, 85 feet long. In their rough hewn state, the sticks of pine intended for yards weighed upwards of 22½ tons each. The sticks were usually drawn to the rivers in the winter over the snow with as many as 48 yokes (96 head) of oxen being used to pull one stick. Therefore, to have had to haul the longest of these sticks around the numerous locksites on the Rideau Canal in summer, even with the use of skids or log rolls, would have been a costly, slow, and arduous process. The Kempt Committee, however, obviously felt that the additional cost of constructing a 33 foot wide lock with a chamber 134 feet long, instead of 124 feet long, was not commensurate with the advantages to be gained; and the locks were constructed with chambers 33 feet wide by 124 feet long. Steamboats could have been designed to take full advantage of the 33 foot width of the lock, and no doubt would have been if the heavy commercial traffic that Lt. Col. By envisaged had developed on the Rideau system. It was technically feasible thereafter to construct steamboats to fit a lock of such dimensions; and the straightening of the several winding sections of the Rideau navigation and the enlarging of the three small Grenville Canal locks on the Ottawa River would have been but minor undertakings in view of the increased shipping capacity to be gained. However, the scale of commercial activity on the Rideau Canal was never such as to require a significant increase, or maximizing, of the capacity of the steamboats employed, and the potential of the 33 foot wide lock was in consequence never fully utilized. To which one might add
that, whatever the apparent deficiencies of the proportions of the Rideau Canal lock approved for construction with respect to the hull dimensions of latter day steamers employed on the system, it was the size of lock that was chosen for construction on the next major inland steamboat canal system to be undertaken: viz. the Trent Canal on which work commenced in 1837, and continued intermittently thereafter with locks being constructed on the same dimensions through to its completion in 1919.
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Endnotes

Preface

1 Great Britain, British Army, Aide-Mémoire to the Military Sciences, vol. III, March 1851, "River and Inland Navigation", p. 257. In exceptional cases, the size of the canal was decided on and then the boats were designed to suit the locks. However derived, the size of the locks in turn determined the scale of the navigation (Loammi Baldwin, Engineer, "Report to Hon. Nathan Willis, Hon. Elihu Hoyt, and Gen. H.A.S. Dearborn etc.", Boston, January 1826, in Report of the Commissioners of the State of Massachusetts on the Routes of Canals from Boston Harbour, [Boston: True and Greene, State Printers, 1826], p. 91).

2 John MacTaggart, Three Years in Canada: An Account of the Actual State of the Country in 1826-7-8 comprehending its resources, productions, Improvements, and Capabilities and including Sketches of the State of Society, Advice to Emigrants, etc., (London: Henry Colburn, 1829), vol. I, p. 163.

3 In contrast to civilian practice, the British military continued to hire day labourers to work directly under the direction and superintendence of Officers of the Royal Engineers or Royal Staff Corps when constructing canals. The military canals on the St. Lawrence River and the Ottawa River Canals were constructed in that manner; but after examining the recently opened Lachine Canal and the Erie canal, both of which were constructed ted by contract, Major-General Carmichael Smyth concluded that the contract system was ultimately

4 The Shubenacadie Canal construction project, 1826-31, is an example of poor workmanship resulting from inadequate supervision. (See Robert W. Passfield, "The Shubenacadie Canal", Agenda Paper - 1978, p. 5).


6 Ibid., Vol. 857, Reel B-2805, p. 473, Captain R.H. Bruyères, R.E., Quebec, to Captain Rowley, R.E., 1 August 1805.


Four Martello towers as well as a number of powder magazines, storehouses, barracks accommodation, and dockyard defence works were constructed at Quebec during the period 1808-1812. The last heavy construction work carried on there prior to this period was the construction of the temporary citadel complex during the years 1780-1781 (Glenn A. Steppler, Quebec, The Gibraltar of North America?, N.H.P. & S. Branch, Parks Canada, Manuscript Report Number 224, 1976, pp. 44-45 and 70-74). Bush goes so far as to state that
Captain By designed the Martello towers erected at Quebec in 1808-1812 (Bush, op. cit., p. 4); but this is not borne out from other sources (see Ivan J. Saunders, A History of Martello Towers in the defence of British North America, 1796-1871, Canadian Historic Sites: Occasional Papers in Archaeology and History, Ottawa, 1976, pp. 29-32).

8 See Bernard Pothier, The Quebec Model, Canadian War Museum Paper No. 9, National Museums of Canada, Ottawa, 1978. A controversy has developed over the years as to the respective roles of Duberger and By in the building of the model. Pothier attributes the original idea of building a model to Major General Gother Mann; but it was clearly Captain By's initiative that led to its being undertaken (see ibid., p. 69, reprint of a letter, Captain John By to General Morse, Inspector General of Fortifications, 7 February 1811). Duberger promised to work with Captain By on the project, both working on their own time and at their own expense when not on duty (see ibid., p. 69, By to Morse, 7 February 1811; and ibid., p. 67, reprint of letter, John B. Duberger, Royal Military Surveyor and Draftsman, to Major-General Gother Mann, 16 February 1807).

9 Bush, The Builders of the Rideau Canal, p. 4. By appears to have taken part only in the first, unsuccessful siege of Badajoz conducted 8 May 1811 to 10 June 1811, and not the second, successful siege conducted from 16 March 1812 to 6 April 1812, as Hill ("The Construction of the Rideau Canal, 1826-1832," p. 118) notes that Captain By was placed in charge of the Royal Gunpowder Mills in January 1812.


11 PAC, MG24, A12, Dalhousie Muniments, Section 3, reel A534, n.p., Lt. Col. By to General Mann, 19 October 1828; and ibid., Lt. Col. By to Lord Dalhousie, 7 December 1828. Lt. Col. By was later, 1826-28, to construct the long Great Kettle span of the seven span Chaudiere Falls bridge crossing according to the principle of truss design that he had invented in 1811 (op. cit., By to Mann, 19 October 1828). When Lord Talbot expressed an interest in By's bridge truss design, the former had a drawing and a 1/4" to 1'-0" scale model made of the 212 foot arched truss Great Kettle span and forwarded it to General Mann for Lord Talbot's perusal and eventual presentation to the Duke of Wellington (op. cit., By to Dalhousie, 7 December 1828).

12 PAC, MG24, I9, Hill Collection, miscellaneous material (1812 to June 1832), Vol. 21, pp. 5384-85. It is not clear from this source whether the Renson bridge was actually built on By's principle of design or whether his design was but one of several submitted for the bridge that was subsequently built. In March 1816, Major By also prepared and presented a scale model of an arched bridge of 1,000 foot span, rising 100 feet above the water, to the Master General and Board of Ordnance. This model was housed by the Royal Engineers Institute at Chatham as late as 1925 (Morgan, "The Story of Colonel By," p. 3) and may still be there. Major By was also among the earliest builders of cast iron bridges. Charles James (Universal Military Dictionary, 4th ed., 1816, p. 63) has an entry to the
effect that several cast iron bridges had recently been constructed by British engineers, and "a portable iron bridge is constructing under the immediate direction of Major By, of the corps of Royal Engineers, the principle of which is highly spoken of." A model of this bridge was deposited at the Ordnance Office in Pall Mall.

13 National Historic Parks and Sites Branch, Parks Canada, Research Notes of Marianne McLean on Powder Mills, 1808-1820, compiled from W044, Vol. 679, title of plans: "Plan for a hydrochemical Press for Gunpowder" by Captain By. There is also listed a reference to a "Plan for a salt-petre refinery," and a "Plan for a brimstone storehouse;" but the notes do not make clear whether these were also the work of Captain By.


15 PAC, RG8, Series C, Vol. 38, Reel C-2616, p. 69, Captain R.H. Bruyères, Commanding Royal Engineer, Quebec, to Lt. Col. Green, Military Secretary to Lt. General Hunter, 16 January 1805; and PAC, MG13, W055, Vol. 857, Reel B-2805, p. 473, Captain R.H. Bruyères, R.E., Quebec, to Captain Rowley, R.E., 1 August 1805.

16 PAC, MG13, W044, Vol. 18, Reel B-1294, p. 65, W. Griffin, Office of Ordnance to General Mann, 10 March 1826.

17 An order, dated 10 March 1826, instructed General Mann to "select a competent Officer of Engineer" to superintend the newly approved (by the Ordnance) Rideau Canal construction project (ibid.), and Lt. Col. By's orders to report for duty at General Mann's office were dated 14 March 1826, only four days later (ibid., W055, Vol. 863, Reel B-2809, p. 209, Lt. Col. Ellicombe, R.E., Pall Mall, to Lt. Col. By, 14 March 1826).
Introduction

1 PAC, MG13, WO44, reel B-1294, vol. 18, Rideau Canal Memorandum, [Board of Ordnance to the Duke of Wellington], 27 May 1826, pp. 144-145. Wellington was visiting in Russia from February through May 1826, and the Board of Ordnance therefore "deferred drawing out the regular instructions for Lt. Col. By until the chief points should be submitted for His Grace's approbation" (ibid).

2 See RG11, Series 1, vol. 38, Lt. J. Jebb, Kingston, to Lt. Col. Durnford, Commanding Royal Engineer, 22 June 1816, pp. 9-21; ibid, 14 July 1816, pp. 23-40; and especially, PAC, Map Division, V1/410, Rideau River - 1816, Lt. Joshua Jebb, "Plan of the Rideau River from its mouth to the Head of Long Island", 20 June 1816, scale 6": 1 mile. The size of Jebb's lock has been scaled off this map. In his report cited above, he does not mention the size of the locks he proposed should be constructed.

3 PAC, RG5, Al, reel C-4614, Civil Secretary's Correspondence, Upper Canada Sundries, vol. 70, Commissioners, Internal Navigation, Third General
Report, [Samuel Clowes' report], To His Excellency
Major General Sir Peregrine Maitland, York, 5 February
1825, K.C.B., Lt. Governor of the Province of Upper
Canada, Major General Commanding His Majesty's Forces
in Upper and Lower Canada etc., 5 February 1825, pp.
D-37269 to D-37328, and especially D-37308 to D-37310.
It is unclear why Clowes wanted his proposed Durham
boat navigation to be 5 feet deep as Durham boats when
fully loaded had a draught of only 28 inches. (John M.
Duncan, Travels through Part of the United States and
Canada 1818 and 1819, Glasgow, 1823, vol. II, p. 118.)

The Rideau Canal Lock Size Debate: Seeamboats versus
Gunboats

1 The importance of the St. Lawrence River supply route
and the efforts made to defend it are set forth in
William Russell, "Bridge Island (Chimney Island)," pp.
102-108 of William Russell, Miscellaneous Historical
Studies, Manuscript Report Number 165, National
Historic Parks and Sites Branch, Parks Canada,
Department of Indian Affairs and Northern Development,
1975. See also two articles cited by Russell: viz.
F.C. Curry, "Little Gibraltar (Bridge Island
Blockhouse)", Ontario Historical Society-Papers and
Records, vol. XXXIII, 1939; and E.A. Cruikshank, "The
Military History of Bridge Island", Recorder and Times
(Brockville), 25 September 1937.
2 Russell, "Bridge Island", p. 102.

3 H.Y. Hind, T.C. Keefer, et al., The Dominion of Canada; containing a Historical Sketch of the Preliminaries and Organization of Confederation; also the Vast Improvements in Agriculture, Commerce and Trade, Modes of Travel and Transportation, Mining, and Educational Interests, etc., etc., for the past Eighty Years under the Provincial names, Toronto: L. Stebbins Publisher, 1868, pp. 133-135. Each batteau had a crew of four and a pilot (tillerman?), and was equipped with an anchor, four oars, and six setting poles shod with iron (ibid, p. 133). For further details, see Edwin G. Guillet, Pioneer Travel in Upper Canada, Toronto: University of Toronto Press, 1966 ed., pp. 43-46; and H.R. Morgan, "Steam Navigation on the Ottawa River", Ontario Historical Society: Papers and Records, XXIII, Toronto: Ontario Historical Society, 1926, p. 372.

4 Russell, "Bridge Island", pp. 102-103. As many as 1,500 batteauxmen were employed during the height of the shipping season (ibid, p. 102).


6 Russell, "Bridge Island", p. 103; and Judith A. Beattie, Gunboats on the St. Lawrence River (1763-1839), Manuscript Report Number 15, National Historic Parks and Sites Branch, Parks Canada, Department of Indian Affairs and Northern Development, 1967, pp. 4-16. Initially, the upper St. Lawrence River was divided into three roughly 15 mile long stretches: viz. Coteau du Lac to Cornwall, Cornwall to Prescott, and Prescott to Kingston, with three gunboats stationed on each section; but at the end of the first year (1813) most of the gunboats were stationed at Coteau du Lac (ibid, pp.

7 Beattie, Gunboats on the St. Lawrence River, pp. 6-9.

8 This information on gunboats has been gleaned from Beattie, Gunboats on the St. Lawrence, pp. 1-27 and p. 64. See also J. Mackay Hitsman, The Incredible War of 1812: A Military History, (Toronto: University of Toronto Press, 1965), p. 111. The rig of the gunboats differed greatly one to another being either of the sloop, schooner, lugger or lateen type (ibid, p. 1). Brigadier General Cruikshank states that 17 gunboats in total were constructed for the protection of vessels on the Montreal-Kingston route; and that of these, three were rigged as schooners, eight as luggers and six as sloops. (Brigadier General E.A. Cruikshank, "notes on the History of Shipbuilding and Navigation on Lake Ontario up to the Time of the Launching of the Steamship Frontenac, at Ernestown, Ontario, 7th September 1816", Ontario Historical Society: Papers and Records, XXIII, Toronto: Ontario Historical Society, 1926, p. 37.

9 Beattie, Gunboats on the St. Lawrence River, pp. 37 and 126.

10 Ibid, p. 105, and pp. 9 and 12. As many as 600 seamen were kept busy manning the gunboats on the St. Lawrence during the war (ibid, p. 27).

11 Ibid, pp. 9, 16, and 35, and especially p. 64.

12 Ibid, p. 9; and Russell, "Bridge Island", p. 103.

13 Beattie, Gunboats on the St. Lawrence River, p. 15.

14 Hitsman, War of 1812, p. 191.
15 Beattie, Gunboats on the St. Lawrence River, p. 64.

16 See Beattie, Gunboats, pp. 1, 9-11, and 16; and Hitsman, War of 1812, p. 167. The gunboats proved remarkably well-suited to all phases of naval warfare on the inland waters. The only deficiency of note was that their small carronades did not have enough firepower to destroy the walls of forts or blockhouses (Beattie, Gunboats, p. 11).

17 Beattie, Gunboats, p. 9. See also Hitsman, War of 1812, p. 136.


19 Beattie, Gunboats, p. 25.

20 Ibid, p. 28.

21 Hitsman, Safeguarding Canada, p. 97.

22 Hitsman, Safeguarding Canada, pp. 117-119.

23 On the reports by the Duke of Wellington, and before him the Duke of Richmond, on the defences of British North America, there is no reference to gunboats per se as related by Hitsman, ibid. But from the role gunboats played in the War of 1812, and the insistence of the Admiralty and Board of Ordnance that the canals to be constructed have locks sufficiently large to pass gunboats, it is obvious that gunboats were being counted on to play a part in any future conflict analogous to their role in the 1812 War. This is made indisputably clear in Major General Carmichael Smyth's 1825 report on the defences of North America undertaken at Wellington's behest. (See PAC, MG12, W055, vol. 1551 (7) miscellanea, reel B-1280, Major General Sir J. Carmichael Smyth et al., "North American Provinces: Commissioner's Report", 9 September 1825, pp. 9, 51, 56, 69, 86, and especially p. 104.)
24 Hind, Keefer et al., The Dominion of Canada, p. 134; and Guillet, Pioneer Travel in Upper Canada, pp. 46-48. In 1818, a total of 315 Durham boats and 679 batteaux passed through the Coteau du Lac locks and by 1833, the numbers were 612 and 863 respectively. See also Morgan, "Steam Navigation on the Ottawa River", p. 371; and D.D. Calvin, A Saga of the St. Lawrence: Timber & Shipping through three generations, (Toronto: Ryerson Press, 1945), p. 111.

25 For a number of eye-witness accounts of the difficulties and high cost of transporting freight and passengers by batteaux and Durham boat up the St. Lawrence River, as well as on the Great Lakes, and the subsequent history of their employment until superseded by steamboats, see Guillet, pp. 48-72.


27 Hitsman, Safeguarding Canada, pp. 119-120.


29 Hitsman, Safeguarding Canada, p. 124.
31 Hitsman in his summary of Wellington's plans for constructing water communications, (Safeguarding Canada, p. 119), does not mention the Ouse (Grand) River-Holland River link; yet it was an essential link in Wellington's scheme as is made clear in Wellington's instructions to Colonel Sir James Carmichael Smyth (See "North American Provinces: Commissioners' Report, 1825", p. 82, section #32). Other British military authorities apparently wished to see a more direct link made between lakes Ontario and Erie by constructing a canal from Burlington Bay on Lake Ontario to the upper reach of the Ouse (Grand) River. (See Robert F. Legget, Canals of Canada, Vancouver: Douglas, David and Charles, 1976, p. 166). The Welland Canal, constructed 1824-29, provided the needed link; but it was in a much more exposed position than the other proposed canals would have been. Interestingly, enough, Wellington subscribed for a number of shares in the first Welland Canal Company. (See R.R. Miller, "The Welland Canal Company and the Duke of Wellington", Ontario History, XLVI, Winter 1953, pp. 63-67.)
32 Hitsman, Safeguarding Canada, pp. 119-120. In the present work, the military role of the Rideau Canal is being elaborated on in the context of Wellington's strategy for the defence of the Canadas. However, the military potential of the Rideau - Cataraqui river systems had been realized years earlier by a number of local military commanders, foremost among whom were the Duke of Richmond and Lord Dalhousie. Indeed, before Wellington took up the Rideau Canal construction scheme, and secured approval for its construction, a much more limited plan of defence had been evolved focusing on a proposed Rideau navigation. This plan entailed: 1) making Kingston the principal military stronghold for Upper Canada and constructing heavy
fortifications there; 2) constructing an interior line of communications to Upper Canada viz the Rideau and Cataraqui river systems; and 3) establishing discharged veterans and their families in military settlements to the rear of the Rideau to develop and strengthen a future local militia for the defence of the proposed communication. In keeping with that plan, the British government acting through the Colonial Office, had established three military settlements in the Rideau corridor at an early date: Perth (1816), Richmond (1818) and Lanark (1820); and the projected Rideau canal was counted on to foster the settlement and economic development of the whole of the Rideau-Cataraqui watershed. (See [R.W. Passfield], "The Perth Military Settlement", pp. 16-21 of Department of Indian Affairs, National Historic Parks and Sites Branch, Rideau Canal, Preliminary Site Study No. 14, Tay Canal Branch: Beveridges-Perth, 1977). Wellington did not apparently concern himself with the economic potential of the projected Rideau Canal; but that may quite legitimately have been regarded by him as a secondary concern best handled by the Colonial Department. He must, however, have counted on the canal fostering settlement in view of the role which he accorded a local militia in his scheme for the future defence of the canal. Serious historical research still remains to be done concerning the military role envisaged for the Rideau communication by the local military commanders prior to 1819 when Wellington incorporated the Rideau Canal construction scheme into his broader strategy of Canadian defence.

33 Ibid., p. 120.
34 PAC, MG13, W055, vol. 1551 (7), Miscellanea, real B-1280, Major General Smyth et al., North American Commissioners' Report, 1825, p. 1 and following. The
commission's instructions are set forth clearly in the questions that they address in the report.

35 Ibid, pp. 68-85, and Appendix B, n.p. There was insufficient water at the source of the Ouse and Holland rivers to operate a canal connecting their headwaters.


38 Lt. Col. By's activities are mentioned in a number of items of correspondence: MG13, W055, reel B-2809, vol. 863, Lt. Col. By to General Mann, 13 July 1826, p. 242; ibid, 1 August 1826, pp. 230-231; ibid., 2 June 1826, p. 223; and RG 8, Series C, reel C-2617, vol. 42, Lt. Col. By to Major General Darling, 13 July 1826, p. 55.


40 Ibid.

41 Ibid, Lt. Col. By to General Mann, 1 August 1826, pp. 230-231.


43 Gillis, Timber Trade, p. 17.

44 Lower, Great Britain's Woodyard, p. 71.

45 Gillis, Timber Trade, p. 52. Square timber was measured by the 'load', where one load comprised 50 cu. ft. A 'deal' was a plank of 3" thickness or more. A 'great hundred' consisted of a parcel of deals, about 120 separate pieces, comprising 230 cu. ft. (Quebec Standard) or 2,760 board feet (Lower, Great Britain's Woodyard, pp. 252-253).
By the mid-1820's, the timber trade was the mainstay of the Canadian export trade as the fur trade had all but disappeared from the St. Lawrence trading system following the absorption of the North-West Company of Montreal by the Hudson Bay Company. Moreover, at this time the potash industry was in difficulties and agriculture in Lower Canada was in a bad state (Gillis, Timber Trade, p. 30). Only the inexpensive transport provided by rafting on the numerous Canadian waterways made it possible to move the timber the great distances required economically (Lower, Great Britain's Woodyard, p. 207).

Lower, Great Britain's Woodyard, pp. 201-209. The basic units used to make up a raft on the Ottawa River, and in the Maritimes, were called "cribs". They were not as well framed as the St. Lawrence River, "drams" and were somewhat smaller, about 20 sticks or some 25 feet wide (ibid, pp. 201-203; and Gillis, Timber Trade, pp. 161-165). The way in which the St. Lawrence drams were built and ferried down the river, is described in detail in a well-illustrated article, "Rafting on the St. Lawrence", by D.D. Calvin (Canadian Geographical Journal, vol. III, No. 4, October 1931, pp. 271-286.


For an excellent history of the introduction of steamboats onto the western rivers of the United States and their economic impact, see ibid, Chapter 1, pp. 3-60.
51 Ibid., p. 59.
53 John P. Heisler, 'A History of Shipbuilding in Canada to 1939', manuscript in preparation, National Historic Parks and Sites Branch, Parks Canada, Department of Environment, p. 108. The Accommodation was 72 feet long on its keel, 85 feet overall, with a 16 foot beam width, and of about 40 tons burthen. It was a passenger vessel powered by a 6 H.P. engine built at the St. Maurice Iron Works near Trois Rivieres, Quebec.

54 For a brief history of the introduction of steamboats into British North America, see Heisler, 'A History of Shipbuilding in Canada', pp. 108-130; and Bush, Commercial Navigation on the Rideau, pp. 20-22.


to be that Philemon Wright operated a Durham boat carrying freight between Hull and Grenville. The first Durham boat, named the Britannica, was superseded in 1819 by another, the Packet. However, Philemon Wright was one of the financial bakers of Thomas Mears who built a steamboat, the Union of the Ottawa at Hawkesbury in 1822. This boat, which took over the freighting business on the Hull-Grenville line, was the first steamboat on the Ottawa River as Wright's Durham boats were, of course, propelled by sails and oars.

(Robert Legget, Ottawa Waterway: Gateway to a Continent, Toronto: University of Toronto Press, 1975, p. 145.


58 Heisler, 'A History of Shipbuilding in Canada', p. 110, See also D. Creighton, The Empire of the St. Lawrence, (Toronto: Macmillan, 1972 ed.), p. 213.

59 Lt. Col. By during his sojourn in Montreal during the summer of 1826 read a report by the Welland Canal Company (MG13, W055, reel B-2809, vol. 863, pp. 232-239, The Welland Canal Company incorporated by Acts of the Provincial Parliament of Upper Canada in the Sessions of 1824 and 1825, Directors' Report, 31 December 1825, Montreal: James Lane, 1826, copy signed by Lt. Col. By, R.E.). In this report, the volume of western trade and the success of the Erie Canal is discussed together with plans for the projected Welland Canal: By, of course, was in contact with the Montreal merchants who were bent on regaining their former ascendancy over the trade of the interior around the Great Lakes basin. (See John P.
Heisler, *The Canals of Canada*, Canadian Historic Sites: Occasional Papers in Archeology and History, Number 8, National Historic Parks and Sites Branch, Parks Canada, 1973, pp. 42-43). The hopes of the Montreal merchants, however, were focused on improving the St. Lawrence River navigation, rather than the long circuitous interior route through the Rideau system; but By was apparently confident that if an uninterrupted steamboat navigation were built through the Rideau system, the merchants would resort to it to avoid the transhipments required at the rapids on the St. Lawrence River route. The comparative distances for the St. Lawrence, Rideau and Erie Canal routes are given in Heisler, ibid, p. 43.

60 Heisler, 'A History of Shipbuilding in Canada', p. 109. The *Swiftsure* had a 130 foot keel and 24 foot beam and, unlike the *Accommodation*, was powered by an imported engine from Boulton and Watt of Birmingham, England.

61 Hunter, *Steamboats on the Western Rivers*, pp. 551-552. The Americans also apparently used steamboats during the War of 1812 on the Hudson River, between New York and Albany, and on Lake Champlain (Cruikshank, "Notes on the History of Shipbuilding and Navigation", p. 37). Moreover, as early as 1816, the British Admiralty had proposed that the projected Lachine Canal should be constructed with locks large enough to pass steamboats as well as gunboats; and that civilians should be encouraged to build steamboats for commercial purposes so that they could be converted into gunboats in time of war (Hitsman, *Safeguarding Canada*, p. 114). However, this proposal appears to have been stillborn as steamboats were not taken into consideration in the strategic planning that preceded the construction of the Rideau Canal; and Lt. Col. By was apparently unaware of this earlier proposal.

62 Ibid., pp. 551-561.
See MG13, W044, reel B-1294, vol. 18, pp. 64-100 for a copy of all of the letters, memoranda etc. contained in the package of instructions sent to Lt. Col. By, dated 21 June 1826.

PAC, RG8, Series C, reel C-2617, vol. 43, Duke of Wellington Memorandum, 10 August 1826, p. 35; ibid., Major General Smyth to General Mann, 17 August 1826, pp. 35-41; ibid, General Mann to Lord Fitzroy Somerset, 26 August 1826, pp. 49-50.

PAC, RG8, Series C, reel C-2617, vol. 43, General Mann to Lord Fitzroy Somerset, 26 August 1826, pp. 49-50; and ibid, Major General Smyth to General Mann, 17 August 1826, pp. 35-41. The planned Rideau appropriation was later scaled down to £15,000, and eventually a sum of £5,000 which was voted by Parliament to cover Rideau expenditures for 1826.

PAC, RG8, Reel C-2617, Vol. 43, General Mann to Lord Fitzroy Somerset, 26 August 1826, pp. 49-50.

PAC, RG8, Reel C-2617, Vol. 43, Major General Smyth to General Mann, 23 August 1826, pp. 43-48.

Ibid., p. 43.

Ibid., pp. 43-48.

PAC, RG8, Series C, Reel C-2617, Vol. 43, Fitzroy Somerset, Office of Ordnance, to General Mann, 1 September 1826, pp. 50-52. This letter conveys the Duke of Wellington's views and instructions.


Jean Lindsay, The Canals of Scotland, (Newton Abbot: David & Charles, 1968, pp. 31-35-36. In 1828, steamboats especially designed to ply on canals were tried out again on the Forth and Clyde Canal, but
caused the same problem. Steamboats were not operated on the Forth and Clyde Canal until 1856 when the introduction of steamboats with screw propellers overcame the problems caused by paddle wheels (ibid., pp. 41 and 46).

73 Andrist, The Erie Canal, p. 21; and Strickland, Reports on Canals, p. 2.


75 PAC, RG5, A1, Civil Secretary's Correspondence, Upper Canada Sundries, reel C-4614, vol. 70, Commissioners, Internal Navigation, Third General Report [Clowes' Rideau Canal Survey Report] To His Excellency Major General Sir Peregrine Maitland, York, 5 February 1825, pp. D-37271 and D-37310. The locks on the Grand Trunk Canal were 8 feet wide by 75 feet long.


77 Strickland, Reports on Canals, pp. 10 and 14.

78 Ibid, pp. 91-92.

79 Stevenson, Sketch of the Civil Engineering of North America, 1838, p. 202; and Strickland, Reports on Canals, 1826, pp. 55f. The Morris Canal, which connected the Delaware and Passaic rivers, had a number of railway inclines as well as locks. Other major contemporary American canals were the Chesapeake and Ohio Canal connecting the Potomac River with the Ohio River at Pittsburgh which was constructed with broad
locks 15 feet wide and 100 feet long on a 6 foot deep navigation; and the Delaware and Hudson Canal constructed with narrow locks 9'-6" wide and 75 feet long.

80 MacTaggart, Three Years, vol. I, pp. 167-168. Even the smaller "crib" timber rafts in use on the Ottawa River would have been unable to pass through a 20 foot wide lock (See Endnote #55).

81 Lindsay, The Canals of Scotland, pp. 144-159; and Gladwin, Canals of Britain, p. 34. Although intended to have a 20 foot depth of water, the Caledonian Canal when opened in October 1822, had only 15 feet of water in the locks and 12 feet of water in the canal cuts (C. Hadfield, British Canals: An Illustrated History, Newton Abbot: David and Charles, 1966, p. 127).

82 Samuel Smiles, Lives of the engineers, with an account of their principal works; comprising also a history of inland communication in Britain, (London: J. Murray, 1862), Vol. II, p. 414.

83 Lindsay, The Canals of Scotland, p. 156.

84 Ibid, pp. 144-159; and Gladwin, Canals of Britain, p. 34. Some 20 miles of the 60 mile long navigation consisted of artificial canal cuts connecting a chain of lochs or lakes, principally Loch Ness, Loch Oich, Loch Lochy, and Loch Linnhe stretching in a line between the Moray Firth at Innverness and the Firth of Lorn.


86 MG13, W044, reel B-1294, vol. 18, Lt. Col. By to General Mann, 1 October 1826, p. 10.

87 Ibid, marginalia dated 5 February 1827.
289

88 MG13, W055, reel B-2809, vol. 863, Lt. Col. By, Montreal, to respective Officers, Quebec, 1 November 1826, pp. 69-70. This is the first correspondence dated from Montreal in the fall of 1826.


90 For an explanation of the structural problems entailed in building sternwheelers, see Hunter, Steamboats on the Western Rivers, pp. 96-97. The problem of building steamboats of lesser draught was not all that simple either as it involved difficulties in constructing a hull that would be both long and shallow and at the same time not lacking in strength and stiffness. During the 1820's and thereafter, the draught of large steamboats was gradually being reduced through the evolution of better hull designs; but as of 1827, steamboats averaging 109 feet long by 20 feet in breadth of roughly 113 tons had hulls about 6 feet deep. The depth of hull was not greatly reduced for steamboats of that size until the 1840's when it was reduced by more than a third, and still more thereafter (Hunter, ibid, pp. 73-74). Given the almost total absence of statistics on the draughts of steamboats when loaded, one must assume that there was a general correspondence between depth of hold and the draught of the boat, although this is not always necessarily so. It is known that c.1838, Ohio River steamboats with a carrying capacity of from 100 to 200 tons had a draught of from four to five feet (Hunter, ibid, p. 653); but this was for riverboat steamboats which were not subject to the strains experienced in sailing on open seas or large lakes such as the Rideau Canal steamboats were expected to do in Lt. Col. By's scheme of things. Fortunately, Lt. Col. By inquired about the draught of the several classes of steamboats in use on the inland
lakes and rivers of the Canadas, and provides information on the same.

John MacTaggart, the Clerk of Works, measured two of the larger sidewheeler steamboats on the Quebec-Montreal run: the Lady Sherbrooke, which was 145 feet stem to stern, 50 feet wide clear of the paddles, with a 10 foot draught; and the Chambly, which was 142 feet long, 50 feet wide overall, and drew 6 feet of water (MacTaggart, *Three Years*, Vol. II, p. 85).

91 PAC, RG 8, Series C, reel C-2617, vol. 42, Lt. Col. By to General Mann, 6 December 1826, pp. 150-151.

92 Douglas Brymer, archivist, *Report on Canadian Archives*, 1886, (Ottawa: Mclean, Roger and Company, 1887), pp. xxix; and Robert R. Legget, *Canals of Canada*, Douglas, David & Charles: Vancouver, pp. 152-153. The size of the lock chambers on the military canals of the St. Lawrence varied considerably; but the gates were a minimum of 12'-6" wide following the 1817 enlargement. In later years, the largest of the Durham boats, which were being constructed to increasingly greater breadths of beam to maximize their carrying capacity, had in a number of cases to be forced through between the gates and several even had up to an inch cut off their gunwales to enable them to squeeze through. This led the Royal Engineers to recommend that passage through the locks should be restricted to boats of 12 foot 3 inch beams or less (PAC, RG8, Series C, vol. 33, reel C-2620, p. 8, Captain R.S. Piper, R.E., to Col. Durnford, 4 August 1831)


94 PAC, RG 8, Series C, reel C 2617, vol. 42, Lt. Col. By to General Mann, 6 December 1826, pp. 148-150. Canadian merchants were equally determined to deny the American free navigation of the St. Lawrence, see Donald Creighton, *The Empire of the St. Lawrence*, (Toronto: Macmillan, 1972 reprint), pp. 236-239.
MacTaggart had assumed that the large locks, if built, would have had a reduced lift and that consequently a greater number of locks would be required. By to the contrary, counted on building the large locks with the same 10 foot lift planned for the 20 foot locks, and in several places was prepared to construct the large locks with a 15 foot lift. (See MG13, W055, reel B-2811, vol. 865, Lt. Col. By to Col. Durnford, 21 April 1828, p. 214). This may well have been a dangerous expedient as Telford's large 40 foot wide locks on the Caledonian Canal had only 7'-9" lifts.


For a comparison of the Rideau Canal route, St. Lawrence route, and the Erie Canal route in terms of feet of lockage and distance from Lake Ontario to the ocean, see Heisler, ibid, p. 43.


PAC, RG8, Series C, reel C-2618, vol. 44, Lt. Col. By to General Mann, 6 July 1827, pp. 80-89.


Ibid, Lt. Col. By to General Mann, 6 July 1827, pp. 81-83. By did not specify where he intended to use the steamboat until later, see PAC, MG 24, A12, Sect. 3, reel A534, Lt. Col. By to Sir, 12 November 1827. For further information on the nature of towpaths, see Aide mémoire, 1851, Part P ... R, pp. 237-238, and p. 278. The general dimensions and type of surfacing used on American canal towpaths are described in Strickland, Report on Canals, Railways, Roads and other subjects, 1826, p. 3.


PAC, RG8, Series C, reel C-2617, vol. 42, Lt. Col. By to General Mann, 6 December 1826, p. 151.


PAC, RG8, Series C, reel C-2618, vol. 44, Lt. Col. By to Lord Dalhousie, 26 October 1827, p. 142. The plans were dated 25 October 1826, but the report and estimates were post-dated to 1 November 1826.
Hudson's Bay Co. Archives, D.5/2, Governor George Simpson's Inward Correspondence, reel 3M56, Lt. Col. By to G. Simpson, 28 October 1827, pp. 309-310. For a list of the contracts advertised, see Montreal Gazette, vol. IV, no. 90, 10 December, 1827.


PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, John By to Sir [Lord Dalhousie], 12 November 1827, n.p.


PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, John By to Sir [Lord Dalhousie], 12 November 1827 n.p. See for example, the Duke of Wellington's opinion quoted in J. Mackay Hitsman, The Incredible War of 1812 A Military History, (Toronto: University of Toronto Press, 1968), pp. 188-189.

PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, John By to Sir [Lord Dalhousie], 12 November 1827, n.p.

Lieutenant Frome, Royal Engineers, "Account of the causes which led to the Construction of the Rideau Canal, connecting the Waters of Lake Ontario and the Ottawa; the Nature of the Communication prior to 1827;
and a Description of the Works by means of which it is converted into a Steam-boat Navigation", [28 February 1837], Papers on Subjects Connected with the Duties of the Corps of Royal Engineers, London: John Weale, second edition 1844), Vol. I, p. 69. For a more detailed exposition of the difficulties faced by the brigades of batteaux transporting supplies up the St. Lawrence River during the War of 1812, see Bill Russell, "Bridge Island (Chimney Island)", Miscellaneous Historical Studies. National Historic Parks and Sites Branch, Parks Canada, DIAND, Manuscript Report No. 165, pp. 102-111.


126 PAC, RG1, E12, vol. 3, Major Phillpotts, Second Report on the Inland Navigation of the Canadas, 3 August 1840, p. 71. See also, RG11, Series 1, vol 41, Phillpotts, Second Report, p. 421. The £500,000 figure appears rather high. It may well have cost £50,000 or thereabouts. Guillet (Early Life in Upper Canada, p. 426) states that it cost the British government £30,000 sterling to transport two vessels in frames, of which one was a brig, from Montreal to Kingston during the War of 1812; and John W. Spurr ("The Royal Navy's Presence in Kingston, Part I: 1813-1836," Historic Kingston, Vol. 25, No. 25, March 1977, p. 69) mentions one warship on Lake Ontario, the 56 gun "Psyche," which was originally a 36 gun frigate that the British government shipped from England in frame and transported up the St. Lawrence to Kingston where it was enlarged and completed at a total cost of £30,000 sterling.
With respect to the speed of transit, By argued further that although it was 54 miles shorter from Montreal to Kingston by way of the St. Lawrence River, it would nonetheless take less time to navigate by way of the Rideau Canal as the dams on the Rideau would transform it into a series of stillwaters with no current to impede the steamboats (ibid, p. 231). In both letters, By states that the voyage from Quebec to Kingston would take 77 hours; yet the times cited for the various legs of the trip do not add up to 77. He may possibly have allowed several hours, totalling 7 for transhipping the guns and supplies from steamboats to Durham boats at the Lachine and Grenville canals and back into steamboats again.

Ibid, p. 231.

See PAC, MG13, W044, Reel B-3459, vol. 613, Lt. Col. Wright, R.E. to Col. Durnford, "Report on the Marmora and Gannanoqui Iron Works, Upper Canada", 8 December 1827, pp. 1-10; and ibid, Lt. Braddley, R.E., to Col. Durnford, "Report on the St. Maurice Iron Works near Three Rivers, Lower Canada", 24 January 1828, pp. 1-27, and appendix to Lt. Braddley's Report, "'On the Marmora Iron Works etc., an Extract from No. 2, Canadian Review', supposed to be written by Dr. Bigsley in the year 1824", pp. 1-11. These are excellent reports on all aspects of the iron foundries extant in the Canadas at that time, and in addition provide some information on several then defunct enterprises. During the War of 1812, the British naval forces on the Great Lakes had
received some of their supplies from the St. Maurice Iron Works such as trucks, shot and various castings (Lt. Braddley, ibid, p. 7).

131 There was a foundry operating at Gananoque commencing in 1800, but it only lasted for several years due to a deficiency of capital (Lt. Col. Wright, op. cit., pp. 2-3). For a much more detailed history of the Gananoque Iron Works, more properly called the Lansdowne Iron Works, see William Russell, "The Lansdowne Iron Works", National Historic Parks and Sites Branch, Parks Canada, DIAND, Manuscript Report No. 216, pp. 420-456. There was also an iron foundry in operation at Long Point on Lake Erie in 1823 (See Edward Allen Talbot, Five Year's Residence in the Canadas including a tour through part of the United States in the year 1823, (London: Longman, Hurst, Rees, Orme, Brown and Green, 1824), vol. I. pp. 337-338). However, it must have ceased operation prior to 1827.


134 MacTaggart, ibid, vol. II, p. 22.

135 N.H. Baird, who succeeded John MacTaggart as Clerk of Works on the Rideau Canal project in 1828, was employed following the completion of the Rideau Canal in surveying and preparing plans for the proposed Trent Canal from the Bay of Quinte via the Trent River to Rice Lake (1833) and from Rice Lake to Lake Simcoe (1835). Although work commenced in 1837 on the Trent Canal section which would have given the Marmora Iron Works a navigable waterway to Lake Ontario, financial difficulties forced postponements. The Trent Canal was thereafter built piecemeal and not completed through from the Bay of Quinte to Lake Huron until the summer

136 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, John By to Sir [Lord Dalhousie], 12 November 1827, n.p. The Gatineau iron ore was mined at a later date with some measure of success, see William Hunter, Hunter's Ottawa Scenery in the vicinity of Ottawa City, Canada, (Ottawa: William S. Hunter jr. publisher, 1855), p. 17.


139 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, John By to Sir [Lord Dalhousie], 12 November 1827, n.p.


141 Ibid, Lt. Col. By to Sir James C. Smyth, 10 December 1827, pp. 229-231. By also assured Major General Smyth that there was an abundance of water in the Rideau system to operate the large locks (ibid, p. 229).
This, of course, was a crucial concern in planning a canal system of any lock size.

142 By explained the details of his large lock scheme to Commodore Barrie in two letters (ibid, vol. 44, 10 December 1827, pp. 225-228; and ibid, vol. 45, 2 January 1828, pp. 10-11). He also conversed with Commodore Barrie on this subject, probably at Kingston during By's January 7th-17th tour of inspection of the line of canal (ibid, vol. 45, Lt. Col. By to General Mann, 23 January 1828, p. 22).

143 PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to General Mann, 23 January 1828, pp. 22-23. It is unclear why Commodore Barrie would have wanted to tow frigates through the large locks "on an even keel". One would think that the war ships could have been towed through comparatively shallower water if they were put on an uneven keel (listed) to raise the keel somewhat. At the close of the War of 1812, the largest frigates built for use on the Great Lakes were about 120 feet long and 28 to 30 feet in breadth with a draught of from 7 to 11 feet. The large frigates had a gross tonnage of 70 to 100 tons, but 25 to 40 tons consisted of iron ballast. Stripped of their ballast, and perhaps their guns, it is quite conceivable that frigates constructed on the Ottawa could have been towed on an even keel through the 50 feet by 150 feet by 5 foot deep lock via the Rideau Canal to Lake Ontario. (The writer is indebted to Walter Zacharchuk, Head, Underwater Archaeology, Parks Canada, for the above information on frigates).

144 Wellington, 22 February 1819, quoted by Hitsman, War of 1812, pp. 188-189.


Escalating Estimates and Expenditures

1 See Rideau Canal editorial, Montreal Gazette, XXXIV, no. 3, 10 January 1828.

2 The arguments in the pamphlet were such as only one who had read By's reports could have written, and among the Officers of the Ordnance only Major General Smyth showed a persistent determination to defend the original decision, his own, in favour of building 20 foot wide locks on the Rideau Canal. The views expressed in the pamphlet were also those of John MacTaggart, the Clerk of Works on the Rideau Canal project; and it is possible that he was the author although questionable. MacTaggart would not have maintained, as the pamphlet did, that the 20 foot wide canal could be constructed for £169,000 or at least would not have done so after the first survey in the spring of 1827.

3 Montreal Gazette, XXXIV, no. 3, 10 January 1828, reprint of a letter, dated London, 21 September 1827, "To the Editor of the Observer, York, Upper Canada". The argument that the Rideau System might not be able to provide the volume of water required to operate the large locks was not far wrong. The leasing of water power rights to a number of mills established on the Rideau system, and the gradual clearing of timber off the slopes of the Rideau watershed resulted in a rapid spring run off which by the 1860's caused the Rideau Canal to experience a shortage of water that made it difficult to operate the navigation in the summer. A number of secondary lakes in the Rideau watershed were then dammed up to serve as additional water reservoirs to rectify the problem. (See J.D. Slater, Superintendent, Report on the Rideau Canal, Appendix no. 7, Canada, General Report of the Commissioners of
Public Works for the year ending 30th June 1867,
Ottawa: Hunter, Rose & Co., 1868, p. 65. Had the large
50 by 150 foot locks been constructed, they would have
aggravated the problem immeasurably.

4 PAC, WO44, reel B-1294, vol. 18, Wellington Memorandum,
31 January 1826, pp. 8-9; and ibid, M. Griffin, Office
of Ordnance to General Mann, 10 March 1826, p. 65.

5 PAC, MG13, WO44, reel B-1294, vol. 18, [Lord Bathurst],
Rideau Canal: Ordered that these papers be sent to the
Master General for His Grace's perusal, 27 May 1826,
pp. 144-147.

6 PAC, MG13, WO55, reel B-2809, vol. 863, R. Byham to
General Mann, 22 November 1826, p. 62 including
marginalia; and ibid, R. Byham to General Mann, 6
December 1826, p. 65.

7 PAC, MG13, WO44, reel B-1294, vol. 19, General Mann to
R. Byham, 30 November 1827, p. 85. This was By's
letter of 4 October 1827.

8 Ibid, General Mann to R. Byham, 30 November 1827, p.
85.

9 Ibid, General Mann to R. Byham, 7 December 1827, p. 74.

10 The Duke of Wellington had resigned as Master General
of the Ordnance which had carried with it a seat in the
cabinet, and as Commander-in-Chief of the Army on 12
April 1827 when Canning's government succeeded that of
Lord Liverpool. The Marquis of Anglesey was appointed
Master General on 30 April 1827 and held that position
until 29 January 1828.

to R. Byham, 13 December 1827, p. 73.

12 Ibid, E.G. Stanley, Under Secretary of State for the
Colonial Department, to R. Byham, 10 December 1827, pp,
82-84. The quote is from p. 84.

13 Ibid, General Mann to R. Byham, 7 December 1827, pp.
74-75, including marginalia, dated 11 December 1827,
p. 75; and ibid, General Mann to R. Byham, 14 December
1827, p. 72. See also, MG13, W055, reel B-2809, vol. 863, Respective Officers, Ordnance Office, Quebec to
William Griffin, Secretary, 16 November 1826, p. 282.
14 PAC, MG13, W044, reel B-1294, vol. 19, General Mann to
R. Byham, 15 December 1827, pp. 66-68.
15 Ibid, marginalia, dated 18 December 1827, on E.G.
Stanley to R. Byham, 10 December 1827, p. 82.
performed on the Rideau Canal from the commencement of
the Service and now in progress, 15 December 1827, pp.
70-72.
67-68.
18 Ibid, marginalia dated 24 December 1827 on General Mann
to R. Byham, 7 December 1827, p. 75.
19 Ibid, Memorandum signed W[ellingto]n, 19 December 1827,
pp. 143-144.
20 Ibid, p. 145. Wellington even questioned whether the
Crown had the right to completely dam up a river as
proposed by Lt. Col. By at several places as this would
prevent the proprietors along its banks from
continuing to float their timber down the river.
21 PAC, MG13, W044, reel B-1294, vol. 19, Memorandum
signed W[ellingto]n, 29 December 1827, pp. 145-152.
Wellington also recommended that Crown lands along the
Rideau navigation that had been granted earlier to
various individuals on the condition that they be
immediately settled should be resumed by the Crown in
the numerous instances where the recipients were seen
to be awaiting the completion of the canal before
entering on the land. This would enable the land to be
thrown open to immediate settlement, and once cleared
and cultivated would render the construction of the
canal much less difficult and expensive (ibid, reel
B-1295, pp. 150-152).

23 The Master General communicated By's plans and estimates, together with General Mann's abstract and Lt. Pooley's progress report to Huskisson on 18 December 1827; and the Ordnance was aware on 24 December 1827 that the Master General was going to constitute a committee of engineers to investigate By's plans and estimates. Interestingly enough, this information was conveyed in the form of marginal comment made by the Duke of Wellington of that date (See MG13, W044, reel B-1294, W[ellingto]n marginalia, dated 24 December 1827, on General Mann to R. Byham, 7 December 1827, p. 75). Wellington's memorandum was dated 27 December 1827, and the order to form the committee of engineers was issued 1 January 1828 (See text above).

24 The date of this order is given in, MG13, W044, reel B-1295, vol. 19, General Mann to Lt. Col. Gosset, 12 January 1828, p. 159.


27 Ibid, General Mann to Major General, Sir Alexander Bryce, 4 January 1828, pp. 157-158. The other members of the Bryce committee were Colonel John T. Jones, and Lt. Col. Edward Fanshawe, Royal Engineers.

28 The work restraint order was issued by General Mann on 5 January 1828 (See RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to General Mann, 15 March 1828, p. 71.

29 The instructions issued to the Bryce Committee are set forth in MG13, W044, reel B-1295, vol. 19, General Mann
to Major General Sir Alexander Bryce, 4 January 1828, pp. 157-158.
33 Ibid, p. 142.
34 The Ordnance would not yet have received By's letter, dated 10 December 1827, advocating that the large locks be built 7 feet deep in keeping with the views expressed by Commodore Barrie. Of course, as noted in the text, By reverted back to advocating a 5 foot depth in a letter forwarded to the Ordnance on 23 January 1828. However, neither letter would have arrived at the time the Bryce Committee was sitting, and consequently their deliberations focused on By's original advocacy of a 50 by 150 by 5 foot deep lock.
35 PAC, MG13, WO44, reel B-1294, vol. 19, Report of the Bryce Committee of Engineers, 22 January 1828, pp. 139-140. The qualification of the wooden locks proposal was repeated in the covering letter submitted to the Ordnance with the completed report (See ibid, reel B-1295, vol. 19, Sir Alexander Bryce, Major General and President, to General Mann, 23 January 1828, p. 156).
36 Major General Smyth was not appointed to the Bryce Committee at its inception; and yet Major General Bryce's comments indicate that Smyth took part in the deliberations of the committee (See ibid, Bryce to Mann, 23 January 1828, p. 155).


41 Ibid, Marquis of Anglesey to Huskisson, 26 January 1826, p. 21.


43 The Marquis of Anglesey resigned the Ordnance on 29 January 1828, and was succeeded as Master General by Lord Beresford. The Duke of Wellington had become Prime Minister on 9 January 1828, succeeding Lord Goderich, and the change at the Ordnance may well have derived from the change of government. Interestingly enough, Sir James Kempt was in turn to succeed Lord Beresford as Master General in 1830, the same year that Wellington's administration gave way to that of Lord Grey, and Kempt held that position until 1834, the year Lord Grey's administration gave way to that of Lord Melbourne.


45 PAC, MG13, WO44, reel B-1294, vol. 19, Huskisson to the Master General, 14 March 1828, p. 24. Huskisson had informed the Ordnance as early as 25 February of his intention to limit the Rideau expenditures to £41,000 in 1828; but the Ordnance at that time had had no

46 Wellington's views, of course, were expressed in his memorandum of 29 December 1827 (ibid, pp. 145-152). Huskisson retained his position as Colonial Secretary under the new Wellington administration until 29 May 1828 when his resignation was accepted over an issue totally unrelated to the Rideau project.


48 PAC, MG13, W044, reel B-1294, vol. 19, Huskisson to Beresford, 26 March 1828, p. 25. See also, MG11, CO43, reel B-3049, vol. 71, pp. 108-115, and RG8, Series C, reel C-2618, vol. 45, pp. 91-97 for copies of the above communication. Huskisson attributed the extremely low cost estimate of Clowes' report to either a very erroneous view having been taken of the difficulties and expense of the undertaking or a culpable attempt having been made to entice government into undertaking the project by deliberately falsifying the estimate (ibid, p. 92).

49 PAC, MG13, W044, reel B-1294, vol. 19, Huskisson to Beresford, 26 March 1828, p. 24. According to By's estimates, £474,844 would cover the construction of the Rideau Canal with 20 foot wide locks with an additional £50,000 required to construct the 50 foot wide locks and £3,000 to enlarge the locks already under construction. Huskisson merely added the total to obtain an estimate for constructing the Rideau Canal with large locks.
50 PAC, MG13, W044, reel B-1294, vol. 19, R. Byham, Secretary to the Ordnance, Copy of Instructions for the Committee appointed to assemble in Canada upon Matters pertaining to the Rideau Canal, 27 March 1828, p. 25.

51 For a summary of the estimates for the fortifications and canal work underway in 1828, see PAC, MG13, W044, reel B-1295, vol. 19, Memoranda No. 1 through No. 4, March 1828, pp. 180-184.


53 PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to General Mann, 15 March 1828, p. 71. The work restraint order received from General Mann was dated 5 January 1828. See also RG5, Al, Upper Canada Sundries, Civil Secretary's Correspondence, vol. 89, Lt. Col. By to Major Hillier, 26 April 1828, p. 048828.


58 PAC, MG13, W055, reel B-2811, vol. 865, Lt. Col. By to Col Durnford, 1 April 1828, p. 209; and PAC, RG5, Al, Upper Canada Sundries, Civil Secretary's Correspondence reel C-6865, vol. 89, Lt. Col. By to General Mann, 5 May 1828, p. 48929.

59 PAC, RG8, Series C, reel C-2618, vol. 45, R. Routh, Commissariat, Quebec, to Major General Darling, Military Secretary, 22 April 1828, p. 155. MG13, W044,


63 PAC, RG5, Al, reel C-6865, Upper Canada Sundries, Civil Secretary's Correspondence, vol. 89, copy of Lt. Col. By to General Mann, 5 May 1828, p. 48926.

64 PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to General Mann, 15 March, 1828, p. 73.


68 PAC, MG24, Al2, Dalhousie Muniments, reel A534, vol. 29, Section #3, Lord Dalhousie, Quebec, to Lt. Col. By, 26 March 1828, n.p. Lord Dalhousie also wrote a letter to the Royal Engineers' Headquarters at Quebec in support of By's actions and the need for additional monies, see MG24, Al2, Dalhousie Muniments, reel A534, vol. 29, Section #3, Lord Dalhousie to Lt. Col. Drinkwater, 20 March 1828, n.p.

70 PAC, RG5, A1, Upper Canada Sundries, Civil Secretary's Correspondence, reel C-6865, vol. 89, Lt. Col. By to General Mann, 5 May 1828, pp. 48927-48929.
72 PAC, RG5, A1, Upper Canada Sundries, Civil Secretary's Correspondence, reel C-6865, vol. 89, Lt. Col. By to Major Hillier, 26 April 1828, p. 048828.
74 PAC, RG5, A1, Upper Canada Sundries, Civil Secretary's Correspondence, reel C-6865, vol. 89, Lt. Col. By to Major Hillier, 26 April 1828, p. 048828.
75 Ibid, Lt. Col. By to General Mann, copy, 5 May 1828, pp. 48927 to 48929.
82 United Empire Loyalist, York, Upper Canada, 24 May 1828.
83 PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to General Mann, 10 June 1828, pp. 208-211. See also, RG5, A1, Upper Canada Sundries, Civil Secretary's Correspondence, reel C-6865, vol. 89, Lt. Col. By to General Mann, 10 June 1828, copy. pp. 49202-49204.
Extensive research has failed to uncover the two minutes dated 8th and 11th March; but their content is obvious by the drift of By's response in which he refers to them.


86 PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to General Mann, 10 June 1828, pp. 208-211. See comment in footnote #198 above.

87 PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By, Royal Engineers Office, Rideau Canal, to General Mann, 10 June 1828, pp. 208-211. See also RG5, Al, Upper Canada Sundries, Civil Secretary's Correspondence, reel C-6865, vol. 89, Lt. Col. By to General Mann, 10 June 1828, copy, pp. 49202-49204. The £147,103.10.0 sum cited appears to be based on constructing the large lock as £147,103.10.0 expended each year over three years when added to the £100,000 projected expenditure in 1828 and the money expended up to January 1828 would roughly be equal to the total of £535,414.03½ of the revised estimate plus the £53,000 extra required to built the large locks.


MG13, W044, reel B-1294, vol. 19, By Order of the Master General, R. Byham, Secretary, Copy of Instructions for the Committee appointed to assemble in Canada upon Matters pertaining to the Rideau Canal, 27 March 1828, p. 25. Copies of the following documents were enclosed with the instructions to the Kempt Committee: the Bryce Committee Report; Clowes' estimate; a general plan of Clowes' line of canal; a plan of the lock proposed by Lt. Col. By; By's estimate forwarded on November 1, 1827; and By's last report, 23 January 1828, setting forth the money expended and the progress of the work to that date.

Ibid.


MG24, A12, Dalhousie Muniments, vol. 31, James Kempt, Lt. General, Proposed outline of the mode to be adopted by the Officers of the Canada Committee in charge of stations in the investigations of questions prescribed in the instructions, 18 June 1828, n.p.


PAC, RG8, Series C, reel C-2618, vol. 45, Lt. Col. By to Sir James Kempt, 26 June 1828, enclosures: Lt. Col. By, Probable Expense of the purchase of Saw Mills etc. on the line of the Rideau Canal, pp. 213-214; and Lt. Henry Briscoe, R.E., Statement of the Number of Acres that will be inundated between Kingston and Brewer's Lower Mill in consequence of doing away with Jack's Rifts, and Bellidor's [sic] Rifts and raising the Dam and Locks at Kingston Mills, p. 214. The mills to be purchased are named in the above enclosure.

The extra expenditures required when added to the original estimate of £474,844.1.2½ makes a total of £597,621.1.8½ rather than £597,676.2.9½ as By states. In general, Lt. Col. By or his clerical staff, were careless in the manner in which he added together his figures although the figures themselves were accurate. The Bryce Committee, for example, in examining By's estimates in detail and checking the calculations found an error of £7,107.11 between the total of the individual items listed and the total stated in By's estimate. (See PAC, MG13, WO44, reel B-1294, vol. 19, Bryce Committee Report, 22 January 1828, Appendix A, p. 134).


1828, pp. 215-219. See also copy of same in MG13, WO44, reel B-1294, vol. 19, pp. 29-30. Although By's instruction were dated 28 June, they were not passed to him until the evening of the next day (See RG8, Series C, reel C-2618, vol. 45, Lt. Col. By, By Town, to Lord Dalhousie, 5 July 1828, p. 223).

104 Up to this time, Lt. Col. By's staff had worked in the Royal Engineers' Office at By Town in paying only occasional visits to the work sites to measure and inspect the work in progress, or to do work in the field such as surveying and levelling.


107 At this time, stone lockmasters' houses had been built at Black Rapids, Long Island and Kingston Mills where the contractors had agreed to bear half the cost in exchange for having the use of the building during the construction period. These were standard buildings of a non-military design or function. Subsequent to the Kempt Committee decision, Lt. Col. By prepared plans for the construction of 22 blockhouses along the Rideau system for the dual purpose of housing the lockmaster and locklabourers and facilitating the defence of the locksite. But only four were built: at the Narrows, Newboro, Merricksville, and Kingston Mills, and one partially completed at Burritts Rapids, when the Board of Ordnance on grounds of economy, decided to postpone the construction of defensive works. The defensible lockmasters' houses on the Rideau Canal were built at a later date c.1838-post 44. (See Canadian Historic Sites Division, Historical Assets of the Rideau Waterway, D.I.A.N.D., Ottawa, 1967).

The spars intended for the Royal Navy were 120 to 130 feet long; and this determined the length of the lock clear of the gates. (See comments below, in the Appendix.)


This was determined by Lt. Col. By who estimated in consequence that it would cost an additional £250,000 to deepen the canal (ibid, p. 28). Lt. Pooley, in his report had assumed that the water level could be raised two feet, to provide seven feet of water with only a minimum of extra embanking in addition to adding two feet to the height of the lock masonry, gates, and dams. He estimated raising the water level two feet, as opposed to deepening the river bed, would cost £138,000 (MG13, W044, reel B-1295, vol. 19, Lt. Pooley to Col. Ellicombe, 7 March 1827, pp. 210-213). When Lt. Col. By first advocated, in July-August 1826, the construction of the 50 by 150 foot lock with 10 feet of water on the sills, he had not yet visited the Rideau-Cataraqui waterways; and he made his recommendation solely on the basis of the overall dimensions and draught of the large lake steamboats that he wished to circulate through his proposed system of canals. As late as October 1827, when Lt. Pooley left for English, the Rideau Canal engineering staff was still convinced that the canal could be deepened to at least seven feet (as witnessed by the report Pooley prepared while in
England), and possibly to ten feet with a minimum of extra embanking, and the raising of the canal structures the corresponding height. But the surveys conducted during the winter and spring of 1828 proved conclusively that the river banks were not high enough to enable the canal to be deepened to even seven feet without being forced to resort to extensive, costly, embanking or equally costly excavation work (as witnessed by Lt. Col. By's report to the Kempt Committee, 28 June 1828). This development, of course, effectively eliminated any further consideration of the question of deepening the navigation beyond five feet.


116 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, Lt. Col. By to Earl Dalhousie, 14 July 1828, n.p.


119 U.E. Loyalist, (York, Upper Canada), 7 August 1828.


121 The Ottawa River timber rafts in use prior to the construction of the various canals were called "cribs" and were somewhat smaller, as well as less well framed, than the "drams" floated down the St. Lawrence River rapids. The St. Lawrence River drams were roughly 33 feet by 100 feet; whereas the cribs were roughly 25 feet wide. Research to date has failed to turn up a figure for the length of a crib; but they may well have
been of the same length as the drams with but fewer sticks in the make-up of the crib accounting for its reduced width.

122 See George K. Raudzens, "The British Ordnance Department in Canada, 1815-55", PH.D. dissertation: Yale University, 1970, p. 167. The Ottawa River canals were not being constructed by the Ordnance; but the Kempt Committee Report was forwarded to Sir George Murray at the Colonial Office from the Ordnance with the remark that the locks of the Ottawa River canals should be constructed to match the approved locks on the Rideau Canal (PAC, MG13, W044, reel B-1294, vol. 19, p. 27, marginalia, dated 17 September 1828, on "Report of the Committee appointed to assemble in Canada upon matters relating to the Rideau Canal, 28 June 1828").


125 Lt. Col. By sent his Clerk of Works, N.H. Baird, to survey and report on the cost of constructing a navigation by way of the Rivière des Prairies route in October 1830. Interestingly enough, By instructed Baird to prepare plans for locks 170 feet by 50 feet with 7 feet of water on the sills, to pass "steam vessels of middling class" (Public Archives of Ontario, Baird Papers, reel #1, N.H. Baird to Lt. Col. By, 31 October 1830, n.p.). Lt. Col. By obviously continued to think in terms of the Rideau-Ottawa canals being enlarged at some future date. In the interim, the lower St. Lawrence River steamboats of middling class, which had a draught of roughly 6 feet, would have been able to steam from Quebec to the foot of the Carillon Canal on the Ottawa if By's plan were followed. (The draught figure for the St. Lawrence steamboats has been
John MacTaggart measured two steamboats plying between Quebec and Montreal: the Lady Sherbrooke which was 145 feet stem to stern by 50 feet clear of the paddles; and the Chambly, which was 142 feet by 50 feet. The steamboats drew 10 feet and 6 feet of water, respectively, when fully loaded (MacTaggart, Three Years, vol. II, p. 85).

126 See for example PAC, MG13, W044, reel B-1294, vol. 18, pp. 216-348, John By "Reports Document K"; [14 January 1831]. This is a thoroughly detailed and itemized account of over 500 items of expenditure on the Rideau Canal showing how much was expended, either below or in excess of the estimate, with an explanation for each discrepancy.


128 Ibid, p. 72, Smyth Memorandum, 14 March 1826.

129 PAC, MG13, W044, reel B-217, vol. 15, p. 275, Lt. Col. By to Col. Ellicombe, 29 May 1833 (italics By's). This letter was written by Lt. Col. By in defence of his actions after the fact. However, there is no reason to doubt the words that By attributes to Major General Smyth or General Mann (see below) as both were in a position to deny his assertions and did not.

130 Ibid, p. 277.


By here is citing Item #9 in the package of instructions, dated 21 June 1826, that he received from the Ordnance in the fall of 1826.

The Ordnance, however, had on a number of occasions commenced large scale construction projects without submitting detailed plans and an estimate to Parliament for prior approval. The Rideau Canal experience was to bring this practice into total disrepute and result in regulations being adopted to prevent it (see text, pp. 168-171).


For the background to the Treasury Lords' confusion over the 1828 estimate, see Raudzens, "The British Ordnance Department in Canada, 1815-55", pp. 168-169. The Ordnance response to the Treasury confirms that By indeed was not informed of the £558,000 estimate that the Kempt Committee inserted in their report (ibid). The new Inspector General of Fortifications, Sir Alexander Bryce who had served as president of the Bryce Committee in January 1828, now accepted By's June 1828 estimate of £576,757 and informed the Treasury that it was both "accurate and necessary" (ibid, p. 175, Sir Alexander Bryce to the Treasury Lords, 30 June 1830).

For a similar comment, see ibid, reel B-1295, vol. 19, p. 54, Lt. Col. By to Col. Durnford, 31 December 1829. The comment as it respects waste weirs is obviously an anachronism. Lt. Col. By was not aware in 1828 that he would have to build waste weirs on the Rideau Canal.

During the late fall and early winter of 1829-30, the land-river communications along the Rideau waterway were virtually impassable, and Lt. Col. By had been unable to collect the measurements of work performed and the plans being prepared for the new works required at the various lock sites. Hence, the regular year end progress report of 31 December 1829 stated only By's disbursements to that date. When, as of 12 January 1830, the roads were passable (on extended sections of the Rideau the winter
roads were along the course of the river, with the
sleighs being driven over the ice once it hardened
sufficiently to bear the weight of the horse and
sleigh), Lt. Col. By had collected the material
required, calculated the additional costs, and
forwarded the supplementary estimate to the Ordnance on
15 March 1830. Although dated 15 March 1830, the
supplementary estimate nonetheless contained
information on the works performed, and the
expenditures incurred, only up to 31 December 1829.

143 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel
A534, n.p., Lt. Col. By to Lord Dalhousie, 14 January
1833. Lt. Col. By did not explain why the waste weirs
had been found necessary in his 30 March 1830
supplementary estimate report; and the Ordnance
subsequently instructed Col. Durnford to report on this
question. For this reply, see PAC, MG13, W044, reel
Fanshawe, 15 July 1831.

144 Ibid, reel B-1294, vol. 18, pp. 164-169, Lt. Col. By to
General Mann, Progress Report, 15 March 1830.

Durnford to Col. Mann, 24 April 1830.

146 PAC, MG13, W044, reel B-1294, vol. 19, pp. 59f., John
By, "Abstract Report of the works on the line of the
Rideau Canal shewing amount of original estimate, sums
expended, and amount when completed", 30 June 1830.

On 23 June 1830, By sent General Mann (ibid, pp.
53-54) a brief report stating the cost of completing
the Rideau Canal in keeping with the supplementary
estimate of March 1830, as well as an estimate for
completing the three Ottawa River canals with locks 134
by 33 feet. Previously, in February 1830, Lt. Colonels
By and Boteler from the Rideau establishment, and Lt.
Col. DuVernet and Captain Hall of the Royal Staff Corps
working on the Ottawa Canals project, had met in a
committee under the presidency of Colonel Durnford to
determine the cost of completing all of the Ottawa
River canals on the scale of the Rideau Canal locks.
See ibid, pp. 52f., Col. Durnford, Grenville, to Lt.
Col. Couper, 8 March 1830.

1831].


149 Quoted by Heisler, The Canals of Canada, p. 64.

Several years later, Lt. Col. By explained with respect
to his first estimate of November 1827 for the
construction of the canal with 20 foot wide locks, that
he had not had the use of "boring machines" in
estimating either the type of material to be excavated
(rock or soil) at the various locksites or the depth at
which good foundations would be found for the
structures. Consequently, he gave a rough estimate and
left any additional costs that might be incurred to be
covered by the customary 1/10 allowed in the estimate
for contingencies. (Ibid, reel B-217, vol. 15, p. 278,
Lt. Col. By to Col. Ellicombe, 29 May 1833.) Why By
did not possess boring tools is not explained. It is
known, however, that By experienced continual
difficulties in obtaining several items of supply from
the Commissariat Department during the course of
construction; and this might well account for this
rather startling deficiency.

150 Ibid, reel B-1294, vol. 19, p. 56, Secretary of the
Ordnance to Hon. J. Stewart, 17 August 1830. The
comments of the Board contained in this letter are
almost a verbatim reproduction of the comments that Sir
Alexander Bryce appended to Col. Durnford's report of
15 July 1831 which was also forwarded to the Treasury
(See Ibid, reel B-1295, vol. 19, pp. 323-324,
marginalia, signed A. Bryce, 4 November 1831). See
also ibid, pp. 314-315, Sir Alexander Bryce, Minute No. 5, 23 July 1830.


152 PAC, MG13, WO44, reel B-1295, vol. 19, pp. 320f., Col. Durnford to Lt. Col. Fanshawe, 15 July 1831. Col. Durnford also explained that the number of bridges that had to be built in keeping with the terms of the Rideau Canal Act of 17 February 1827 could not be determined until the Surveyor General of Upper Canada gave a ruling, which had been requested, on which of the Rideau Canal crossings bisected by the canal were "public roads". Article XI of the Rideau Canal Act stated: "that when it shall appear necessary to cut into any Highway, in order to construct the said canal, ... the officer shall, within one month cause to be constructed a secure, sufficient, and commodious Bridge, for the passing of Carriages, in order to re-establish the communication between the several parts of such Highways." (For the terms of the Act, see Ibid, vol. 20, pp. 25-30.)

153 Ibid, p. 322. Durnford explains herein why it had taken so long to forward Lt. Col. By's progress report for 1830 (dated 8 January 1831) to the Ordnance.

154 Ibid, p. 318, Lt. Col. By to Sir Alexander Bryce, Progress Report, 8 January 1831. To substantiate his claims as to the debilitating effect of the lake fever on the Rideau Canal work force, Lt. Col. By drafted a statement, dated 24 February 1831, giving a site by site breakdown of the number of men who had died or were incapacitated as a result of contacting the sickness (See PAC, MG13, WO44, reel B-1294, vol. 18, p. 481).

155 PAC, MG13, WO44, reel B-1294, vol. 18, p. 465, John By, "Abstract Statement to the 31 December 1830"; and ibid, pp. 466-469, John By, "Statement Shewing the Total
Amount of Works on each Section as approved by the Committee, the Expenditures up to the 31 December 1830 and the Sums required to complete". Neither the abstract nor the full statement are dated, but they were enclosed with Col. Durnford's 15 July 1831 report. The 8 January 1831 progress report, also enclosed, did not mention any increase on the supplementary estimate, and so it is obvious that the necessity of the increase became known some time between the 8 January and the 15 July 1831.


157 Raudzens, "The British Ordnance Department in Canada", pp. 180-181; and Col. C.G. Ellicombe memorandum, 10 February 1832, printed in the appendix, p. 513, of the "Report from the Select Committee Appointed to take into consideration the Accounts and Papers relating to the Canal Communications in Canada, 1832, British Parliamentary Papers, Colonies Canada, Vol. 6, Session 1825-32. Raudzens states that By's report was received at the Ordnance in November 1831; but Ellicombe states it was received on 3 September 1831, and when forwarded to the Treasury Board was accompanied by a report, dated 4 November 1831, of Sir Alexander Bryce, the Inspector General of Fortifications, attesting to the necessity of By's expenditures.

158 PAC, MG13, WO44, reel B-217, vol. 16, pp. 3-4 "Copy of Treasury Minute, dated 25 May 1832". The sum actually voted by Parliament to cover Rideau Canal expenditures to the close of 1831, was £692,666.

159 Ibid, p. 4.

160 Ibid, p. 8, Col. Ellicombe, Pall Mall, to Col. Nicolls, Commanding Royal Engineer, Canada, 1 June 1832.

161 The opening ceremony and voyage is described by Legget, Rideau Waterway, pp. 56-57; and E.F. Bush, The Builders

162 Ibid, p. 69.

163 PAC, MG13, W044, reel B-217, vol. 15, p. 264, J. By to Col. Fanshawe, 14 February 1833. Four block houses and seven bridges were built by Lt. Col. By on the Rideau Canal. Although the Ordnance had decided to postpone the building of blockhouses as early as 17 August 1830, Lt. Col. By was apparently not immediately informed of that decision. On 26 December 1831 contracts were let to William H. Tett to construct a blockhouse at the Narrows and at the Isthmus, and on March 10, 1832 to Robert Drummond to build a blockhouse at Kingston Mills (See PAC, RG 8, Series C, reel C-2621, vol. 54, p. 57, Captain Bolton, Return of Contracts for Works on, and connected with, the Rideau Canal, not yet completed, 12 November 1832). A blockhouse was also constructed at Merrick's Mills and another commenced, but never finished, at Burritts Rapids. In the absence of any instructions from London, Lt. Col. By took it upon himself to commence several blockhouses where he believed they were absolutely necessary and could be constructed at a great saving while the contractors had their men and tools already on the site (See Canadian Historic Sites Division, Department of Indian Affairs and Northern Development, Historical Assets of the Rideau Waterway, p. 30). Lt. Col. By was probably informed of the Board's decision to postpone the purchase of land for military purposes and the building of blockhouses in the spring of 1832. He was definitely aware of that decision by 30 April 1832 (See Ibid, p. 172, Lt. Col. By to Respective Officers, Quebec, 30 April 1932).


166 For further commentary on the proceedings to which Lt. Col. By was subjected and the disappointments that he suffered, see Hamnet P. Hill, "The Construction of the Rideau Canal", Ontario Historical Society Papers and Records, vol. XXII, Toronto: Published by the Society, 1925, p. 123; and Edward F. Bush, The Builders of the Rideau Canal, 1826-32, Manuscript Report No. 185, pp. 70-73.

167 During the course of the extended Treasury investigation into his Rideau Canal expenditures, Lt. Col. By wrote a number of letters to the Ordnance in defence of his conduct, and indeed continued to do so until he was stricken on 13 August 1834 with a serious attack of apoplexy and paralysis which eventually resulted in his death on 1 February 1836 at age 53. The best summaries of his arguments are to be found in PAC, MG13, W044, reel B-217, vol. 15, pp. 272-280, Lt. Col. By to Col. Ellicombe, 29 May 1833; and ibid, vol. 16, pp. 13-18, Lt. Col. By to Major General Pilkington, 22 July 1833.

168 In his November 1828 progress report By predicted that he would expend £137,216 per annum for three years, 1829, 30 and 31; and in his March 1830 supplementary estimate report, he stated that in keeping with the new estimate, he would probably require £200,000 in 1830 and £211,993 to complete the canal in 1831. The actual disbursements in payment for work performed were £196,605 in 1829, £221,184 in 1830, £133,496 in 1831, and £71,000 in 1832. (The figures for By's disbursements for work done are taken from PAC, MG13, W044, reel B-217, vol. 15, p. 285, S. Thomas, "Statement of the Receipts and Expenditure on account
of the Rideau Canal from 1826 to 31st December [1832].")

169 In the face of rising expenditures on the Rideau Canal project, Sir James Kempt, who had succeeded Lord Beresford as Master General of the Ordnance in 1830, did issue instructions that Lt. Col. By was not to undertake any new work "unless the same should be deemed of pressing importance, and essentially necessary for the due completion and security of the canal" (Ibid, reel B-1295, vol. 19, p. 319, J. K[empt] Minute, 21 May 1831). This was a virtually meaningless admonition as the work that By was carrying out was essential to the completion of the canal. The latter part of the statement, however, may well account for Lt. Col. By taking it upon himself to build several blockhouses where he believed they were absolutely necessary to the defence of the canal.


A Broader Perspective


2 Actually, Parliament had voted £692,666 to cover expenditures to the cost of 1831, which left £783 to be voted to reach the supplementary estimate of £693,449.

3 See PAC, MG13, W044, reel B-217, Vol. 16, pp. 24-25, R. Byham, Secretary of the Ordnance, June 1826, "No. 9, Instructions for the Respective Officers of the Ordnance at Quebec, Montreal and Kingston, and the Inspector of Accounts, in regard to the mode to be adopted in making payments and keeping accounts of the expenses of forming the Rideau Canal." A copy of the above may be found in ibid., reel B-1298, Vol. 24, pp. 500-02.

5 PAC, MG24, A12, Dalhousie Muniments, Section 3, reel A534, n.p., Lt. Col. By to Col. Ramsay, 7 December 1828. Sir George Murray was appointed Secretary of State for the Colonies in May 1828 in the Duke of Wellington's administration and held that position until November 1830. He succeeded Sir James Kempt as Master General of the Ordnance in 1834, and held that position until 1846.


7 Sir James Kempt's position is expressed in R. Byham, Secretary of the Ordnance to Hon. J. Stewart, Treasury Board, 5 July 1831, British Parliamentary Papers, Vol. 6, p. 547. See also, Raudzens, "The British Ordnance Department in Canada, 1815-55," p. 178. For an indication of the attitude of the Colonial Department on placing limitations on contracts, see footnote no. 12 below.

8 The package of instructions forwarded to Lt. Col. By from the Ordnance on 21 June 1826, may be found in PAC, MG13, W044, reel B-1294, Vol. 18, pp. 64-100. See especially, No. 4, p. 78, W. Horton, Colonial Department to W. Griffin, Ordnance, 18 April 1826; No. 8, p. 98, Duke of Wellington, General Minute, 15 June
1826; and No. 9, R. Byham, Secretary of the Ordnance, Instructions for the Respective Officers. For the location of copies of the latter, see footnote no. 4 above. A reading of By's instruction makes it clear that he was not limited in his expenditures; and that is the conclusion he drew (See Major Eliot, Aide-de-Camp to Lord Dalhousie, to Captain George Burke, 16 June 1826, quoted in Legget, *Rideau Waterway*, p. 60.

9 Report from the Select Committee appointed to take into consideration the Accounts and Papers relating to the Rideau Canal, ordered by the House of Commons to be printed 22 April 1831, *British Parliamentary Papers*, Vol. 6, p. 331.


12 Copy of Treasury Minute, dated 10 June 1831, ibid., p. 546; and Copy of Treasury Minute of 8 July 1831, ibid., p. 548. Interestingly enough, although the Colonial Department did not object to the imposition of the new regulations covering contracts in 1831, Robert Wilmot Horton, the Under Secretary of State, was in agreement with the Ordnance position that contracts could not be formed on the principle of limiting payments to the sum voted by Parliament each year. Horton gave evidence to the Select Committee of 1831 to the effect that "I wish distinctly to say, you cannot execute a work by contract, if you are merely to limit the expenditure to the proportions which each separate year may afford for the purposes" (Minutes of Evidence, Report of the Select Committee, 22 April 1831, ibid., p. 358). The Colonial Department therefore in 1826 had agreed to open ended contracts being entered into for the Rideau
Canal project; but as Horton noted, it had been assumed that the preliminary estimate of £169,000 was accurate and would not be exceeded (ibid., p. 358).

13 The four regulations are set forth in the Treasury Minute of 10 June 1831, ibid., p. 546.

14 See Copy of Treasury Minute, dated 7 February 1832, British Parliamentary Papers, Vol. 6, p. 528; C.G. Ellicombe Memorandum, 10 February 1832, ibid., p. 540; and Copy of Treasury Minute, dated 11 May 1832, ibid., pp. 540-41.

15 Lt. Col. By does not appear to have been informed of the new financial regulations adopted in July 1831. In all of his letters in defence of his expenditures in excess of the 1831 parliamentary grant, he cites the precedent of his previous overruns and his instructions. He does not take the new regulations into account in his explanations of his conduct; and hence he was probably not aware of their existence. Had he been, the arguments in defence of his conduct would have been cast somewhat differently, but no less telling.

16 This danger was reported to the Ordnance in 1828 (see text, p. 95), and was common knowledge. See for example, PAC, MG13, W044, reel B-1294, Vol. 18, p. 214, Col. Durnford to Col. Couper, 24 April 1830.

17 See Copy of Treasury Minute, dated 7 February 1832, British Parliamentary Papers, Vol. 6, p. 528; C.G. Ellicombe Memorandum, 10 February 1832, ibid., pp. 539-40; and Copy of Treasury Minute, dated 11 May 1832, ibid., p. 540. See also, Raudzens, "The British Ordnance Department in Canada, 1815-55," pp. 180-81.


19 Ibid., p. 335. This quotation, contained in the Select Committee Report, is taken from the report of a House of Commons Finance Committee of 1817, which also
criticized the Ordnance for undertaking work on major Colonial construction projects without any estimate or general plan being prepared so that the House of Commons was kept in ignorance of the ultimate cost of the projects for which money was granted each year.

Expenditures on Colonial defence projects were extremely unpopular at the time that Wellington was evolving his scheme for the defence of British North America; and Wellington was loath to bring Smyth's report of 1825, which outlined the costs of the various projects required to realize that scheme, before even the Tory administration of the day of which he was a member. Wellington realized in 1826 that it would "be impossible to go before Parliament" with a request for monies on the basis of the whole defence scheme, and had suggested that "a secret committee" of the House be appointed to enable the Ordnance to gain approval for the expenditures required. The government refused, and thereafter resorted to requesting a series of partial grants from Parliament without revealing the scope or ultimate cost of the projects until construction work was well underway. (see J. Joseph Greenough, The Halifax Citadel 1825-60: A Narrative and Structural History, Manuscript Report number 154, Volume 1, National Historic Parks and Sites Branch, Parks Canada, Department of Indian Affairs and Northern Development, 1974, pp. 24-25; and Glenn A. Steppler, Quebec: The Gibraltar of North America?, Manuscript Report Number 224, N.H.P. & S. Branch, Parks Canada, DIAND, 1976, p. 111.) Greenough points out that the works that were finally constructed all cost more, and some far more, than Smyth's preliminary estimates. He concludes that not only did Smyth show poor judgement in preparing such unrealistically low estimates; but "possibly the unrealistic estimates reflect Smyth's familiarity with political conditions in England and his awareness that
excessive costs would deter Parliament from accepting his recommendations" (Greenough, op. cit., pp. 37 and 40).


22 Raudzens ("The British Ordnance Department in Canada, 1815-55," p. 115), compares the preliminary estimate of £169,000 for the Rideau Canal with the final cost of £822,000 and on that basis takes Lt. Col. By to task for a five-fold increase in costs over the estimate. Raudzens contrasts this with the other projects in the Smyth report, the projected cost of which had increased on the average by only 1/5 in the engineering estimates submitted to the Ordnance in 1828. But this is not a valid comparison as it does not take into account the final cost of the projects actually completed or how the preliminary estimate was arrived at. A more valid comparison would be to contrast the estimate of the Commanding engineer on the various projects actually undertaken with the final cost in each case; but even then allowances would have to be made for the particular difficulties faced by Lt. Col. By on the Rideau project (see text below).

23 Raudzens (ibid., p. 199) accuses Lt. Col. By of "spending unjustifiably excessive amounts of money" on the Rideau project; and H.H. Burgess, the Chief Clerk of the Rideau establishment who was dismissed in April 1829 for drunkenness and suspected bouts of insanity, accused By of peculation, graft, misuse of funds and fraud. Burgess took his charges to the Ordnance which ordered a court of inquiry convened in By Town under the presidency of Colonel C. Nicolls. The court convened in November 1831, but Burgess who had received expense monies to come to By Town, fled rather than testify. (See E.F. Bush, The Builders of the Rideau
Burgess's charges and Lt. Col. By's refutation of the same may be found in PAC, MG24, A12, Dalhousie Muniments, Section 3, reel A534, n.p., Lt. Col. By to Lord Dalhousie, 8 June 1832. The report of the proceedings of the Court of Inquiry at By Town may be found in MG13, WO44, Vol. 26, Reel B-1299, pp. 1-124.

24 Legget, *Rideau Waterway*, p. 60. Lt. Col. By also kept a close watch on the receipts and issues of stores through a Board of Survey established for that purpose (See PAC, RG8, Series C, Vol. 244, p. 60, Orders signed by Lt. Col. By, 4 October 1830).


26 See Report of the Select Committee appointed to take into consideration the Accounts and Papers relating to the Canal Communications in Canada, 1832, Ordered by the House of Commons to be printed 29 June 1832, *British Parliamentary Papers, Colonies, Canada*, Vol. 6, Sessions 1825-32, pp. 513-57. During the course of the inquiry, Col. Durnford testified that the Rideau Canal structures were "magnificent works, and done in a most substantial manner" (ibid., Minutes of Evidence, p. 518); and Col. Ellicombe testifying on behalf of the Ordnance, declared that the completion date had been delayed one year because of "sickness and unforeseen casualties," but "yet the work as a whole may be said to have been executed most rapidly" (ibid., Minutes of Evidence, p. 539).

27 Raudzens (*The British Ordnance Department in Canada, 1815-55*, p. 166), notes that the Treasury Board was antagonistic toward By personally as well as against the Ordnance. This hostility is evident in the actions of the Treasury. At one point during the inquiry, the Treasury Board accused By of "conduct unbecoming of an
Officer" for building two houses on government land at By Town. When By pointed out that the two houses in question were paid for out of his own pocket and that of Lt. Pooley to house his family and Lt. Pooley respectively, the Treasury retracted the charge, but refused to reimburse Lt. col. By his costs of £800 even though the building had been expropriated for use by the government. Similarly, when the Ordnance sought to present Lt. Col. By at a Royal levée as a mark of recognition for his accomplishments, pressure was exerted by the Treasury Board and other elements of the Reform government to deny By his due. (Bush, The Builders of the Rideau Canal, 1826-32, p. 73; and Raudzens, "The British Ordnance Department in Canada, 1815-55," pp. 73 and 194).

28 Select Committee Report, 29 June 1832, British Parliamentary Papers, Vol. 6, pp. 514-15. The Select Committee examined Lt. Col. By's report of the projected costs of constructing a canal on Rivière des Prairies to the north of Montreal, as well as the Rideau Canal papers and estimates. With respect to the former, it was reported that "the committee after what has passed with regard to the Rideau Canal, do not think it would be prudent to rely on their accuracy" (ibid., p. 515).

29 Oddly enough, considering that Lt. Col. By was originally censured for his expenditures exceeding the 1831 parliamentary grant contrary to the new regulations imposed by the Treasury Board on 8 July 1831, Col. Ellicombe was not questioned as to whether Lt. Col. By had been instructed to comply with the new instructions or even informed of their existence.

30 Select Committee Report, 22 April 1831, British Parliamentary Papers, Vol. 6, p. 333.

31 The Select Committee of 1831, of course, had recommended the four regulations that Treasury Board
subsequently imposed on the Admiralty, Colonial Department and the Ordnance; and the 1832 Select Committee subjected William Sargent, Superintendent of the Commissary Department, to a thorough questioning as to what control the parliamentary grant exercised over the Commissariat's payments to Officers of the Ordnance. This questioning revealed that the Commissariat had always cashed drafts drawn by Officers of the Ordnance, providing proper vouchers were submitted, regardless of whether the sums demanded in any given year exceeded the amount voted by Parliament. (Select Committee Report, 29 June 1832, ibid., Minutes of Evidence, pp. 521-22.)

32 PAC, MG24, A12, Dalhousie Muniments, Section 3, reel A534, Lt. Col. By to Lord Dalhousie, 14 January 1833.
38 See PAC, RG8, Series C, Vol. 45, Reel C-2618, p. 227, Lt. Col. By to General Mann, 5 July 1828; and PAC, MG13, WO44, Vol. 19, Reel B-1294, p. 28. Report of the Kempt Committee, 28 June 1828. Both Lt. Col. By and the Kempt Committee in their respective reports to the Ordnance cited above, stated that the £576,757 June 1828 estimate included a sum to cover the removal of mills and compensation for the lands that would be drowned; but neither report made it clear that the
estimate for these items was incomplete and would have to be augmented at a later date.

39 PAC, MG13, W044, Vol. 15, Reel B-217, pp. 264-66, Lt. Col. By to Col. Fanshawe, Assistant Inspector General of Fortifications, 14 February 1833. At the time Lt. Col. By, in retirement at his Shernfold Park estate in Sussex, explained the understanding that had existed with the Kempt Committee as to the incomplete nature of the property damages item in the June 1828 estimate, Lt. General Kempt was Master General of the Ordnance. Hence had there not been such an understanding, he was in a position to contradict Lt. Col. By's assertion.

40 The Ordnance was aware from the outset of the Rideau Canal project that land owners would make exorbitant demands for their lands if Lt. Col. By could not get title to the land immediately (PAC, RG8, Series C, Vol. 43, Reel C-2618, pp. 134-35, Major General J.C. Smyth to General Mann, 26 October 1826); but no steps were taken to secure an Act of the provincial legislature to force land owners to accept a fair settlement for whatever lands might be expropriated for the construction of the canal. Once construction was underway, the worst fears of the Ordnance were realized as property owners launched legal actions against Lt. Col. By seeking exorbitant sums in compensation for their lands. The problems Lt. Col. By had with the land problem and the various claims and settlements made are to be found in scattered references in the following volumes: PAC, RG8, Series C, Volumes 43-46, Reel C-2618, and Volumes 47-50, Reel C-2619; MG13, W044, Volumes 15-16, Reel B-217; and ibid., Vol. 18, Reel B-1294.

41 Rideau Canal Act, 17 February 1827, Section 9, quoted in Heisler, The Canals of Canada, p. 77.

42 Heisler, The Canals of Canada, p. 76.

43 Ibid., pp. 76-77.
Among the several contractors who died of the fever were Samuel Clowes, the contractor for Brewer's Lower Mills, Bellidore's Rifts, and Jack's Rifts, and John Sheriff, the contractor at Chaffey's Mills (PAC, MG24, A12, Section 3, Reel A534, n.p., Lt. Col. By to Col. Ramsay, 7 December 1828).

Among the major contractors who abandoned their work on the canal were Walter Fenlon, who had the original contract for the canal works from the head of the Ottawa flight locks to the Hog's Back inclusive (PAC, RG8, Series C, Vol. 48, Reel C-2619, p. 116, W.W. Fenlon to Lt. Col. By, 18 June 1828); John Brewer, who had the original contract for clearing out Cranberry Marsh and the Round Tail and constructing the canal works at Upper Brewer's Mills (PAC, MG13, W055, Vol. 868, Reel B-2813, pp. 105-96, R. Byham to Sir. A. Bruce, 11 November 1831); and William Hartwell, who had the original contract for the canal cut required between Clear and Indian lakes and the extensive summit cut across the Isthmus between Mud and Rideau lakes (PAC, MG13, W055, Vol. 869, Reel B-2814, pp. 236-37, Lt. Col. By to Respective Officers, Quebec, 4 December 1830; and RG8, Series C, Vol. 49, Reel C-2619, p. 1, William Hartwell, By Town, to Lt. Col. By, October 1828).

48 PAC, RG8, Series C, Vol. 49, Reel C-2619, p. 82, Lt. Col. By to Col. Durnford, 1 August 1829. At the Isthmus where By employed Royal Sappers and Miners to complete the work abandoned by the contractor, he had to increase his estimate for the cost of rock excavation from the original contract rate of 4s. per cubic yard to 7s.6d. per cu. yard and even to 8s.6d. on sections where water flooded through the rock to cover the actual cost of doing the work (PAC, MG13, W055, Vol. 869, Reel B-2814, pp. 236-37, Lt. Col. By to Respective Officers, Quebec, 4 December 1830).

49 At Brewer's Upper Mills after John Brewer abandoned the works, the contract price for the masonry work had to be increased from Is. per cubic foot of finished masonry to Is. 4d. before Robert Drummond the contractor at Kingston Mills would take over the Upper Brewer's Mills work. However, Lt. Col. By made it clear that the increase was required because the stone for the lock had to be procured six miles distant from the site rather than on site as had been anticipated at the time of forming Brewer's contract; and By reported that had Brewer's work been progressing in a satisfactory manner, the increase in the masonry price would have been extended to him (PAC, MG13, W055, Vol. 868, Reel B-2813, R. Byham, Secretary to the Ordnance, reporting on the Rideau Canal project to Sir. A. Bryce, 11 November 1831).

50 The four major contractors who saw their work through to a conclusion were: Thomas McKay, John Redpath, Robert Drummond, and Thomas Phillips and Andrew White (PAC, MG24, E6, John MacTaggart Papers, A friend to Justice an Merit [Thomas Phillips], The Following Notices of the Rideau Canal in which is made clear the exalted worth of the Superintendent of that stupendous
work, Colonel By of the Royal Engineers. Kingston, Upper Canada: Patriot Office, January 1832, p. 9).

Phillips and White worked together under a single contract while the others contracted for separate works. Nonetheless all five of the men, who were Montreal masonry contractors and stonemasons, had formed privately what was in effect a joint venture partnership whereby the looses/profits on the various works for which they had contracted were to be pooled. When the partnership was dissolved on 27 April 1831 on the completion of their respective works, the total profits were divided into four equal parts (Legget, Rideau Waterway, pp. 166-67).

Thomas McKay built the first masonry span of the Chaudière bridges crossing the Ottawa River, contracted for the locks in the Entrance Valley and at Hartwell's, and constructed the Commissariat building in partnership with John Redpath. Redpath, in addition to working on the Commissariat building, contracted for the masonry and excavation work required to erect the locks and the high arched dam at Jones' Falls. McKay and Redpath also built in partnership three stone barracks buildings on Barracks Hill to house the military detachment stationed on the Rideau. Robert Drummond built the Royal Engineers' building in the Entrance Valley as well as erecting three wooden truss spans and the 212 foot arched truss of the Great Kettle span in the Chaudière bridge crossing; and he contracted for the large dam and the locks at Kingston Mills. In addition to completing the work at Kingston Mills, Drummond took over and completed the lock masonry work at Lower Brewer's, Upper Brewer's, and Davis after the original contractors had failed. Drummond built the steamboat 'Pumper', launched at Kingston in July 1829, which was used to pump water out of the coffer dam at Kingston Mills and later carried Lt. Col. By on his inaugural
voyage through the Rideau Canal from Kingston to By Town on 24-25 May 1832. Phillips and White contracted for the high masonry arched dam at Long Island and the excavation and lock masonry there as well as the low overflow dam and lock at Black Rapids.

In addition to the eighteen contractors who initially contracted in the period May 1827 through to February 1828 to complete the works then envisaged as being necessary to the completion of the Rideau Canal, there were a number of subcontractors as well as several additional contractors who subsequently took over parts of the work. The initial eighteen major contractors were as follows: John Pennefeather (Entrance Valley excavation work); Thomas McKay (masonry work of Entrance Valley locks); Walter W. Fenelon (excavation and masonry work head of Entrance Valley to Hog's Back inclusive); Philemon Wright and Sons (second stone arch of Chaudiere bridge crossing, Dow's Swamp embankment, and excavation and masonry work at Burritt's Rapids); Thomas Phillips and Andrew White (excavation and masonry work, Black Rapids and Long Island); A.C. Stevens and Co. (excavation and masonry work at Nicholson's Rapids and Merrick's Mills); James Clowes (excavation and masonry work, Clowes' Quarry); Edward W. Thompson (excavation and masonry work, Maitland's Rapids); Bell, Richardson and Co., (excavation and masonry work, Edmund's Rapids, Phillip's Bay, and Old Sly's Rapids); Rykert, Simpson and Co. (Smith's Falls); John Ferguson (excavation and masonry work, First Rapids and work at Oliver's Ferry); William Hartwell (excavation work at the Narrows, the summit isthmus between Rideau and Mud Lakes, and the isthmus between Mud and Clear lakes); John Sheriff, Haggart and Co. (excavation and masonry work at Chaffey's Mills); Donald McLever (excavation and masonry work, Davis Rapids); John Redpath (excavation
and masonry work, Jones' Falls); John Brewer (clearing out Cranberry Marsh, excavation and masonry work at Brewer's Upper Mills); Samuel Clowes and Sons (clearing out Cataraqui Creek, excavation and masonry work at Brewer's Lower Mill, Billidore's Rifts, and Jack's Rifts); and Robert Drummond (excavation and masonry work, Kingston Mills).

51 Lt. Col. By had three silver cups made in England which he presented to Robert Drummond, Phillips and White, and John Redpath in appreciation of their outstanding performance on the Rideau (Legget, Rideau Waterway, p. 106). Thomas MacKay, who was Redpath's partner, must have been intended to share in the cup presented to Redpath in the same manner as the other partnership of White and Phillips shared a cup. Lt. Col. By would have by no means let McKay's contribution to the successful completion of the Rideau project remain unmarked by such a gesture. Robert Drummond also received as a further token of appreciation in the form of a silhouette of Lt. Col. By on the reverse of which the latter had inscribed: "Mr. Drummond from Lt. Col. By, R.E., Rideau Canal, January 1832" (Legget, Rideau Waterway, p. 107).


56 Ibid., p. 264, Lt. Col. By to Col. Fanshawe, 14 February 1833. The Treasury Board in April 1833 was of the opinion that the £11,139 expended on repairs ought to be chargeable to the 1832 operations and maintenance grant for the Rideau Canal rather than being included in the cost of constructing the canal (ibid., p. 270, Extract of Treasury Minute, dated 23 April 1833); but thereafter it was decided to include that expenditure in the cost of constructing the canal (ibid., p. 286, Copy of Treasury Minute, 2 July 1833).

57 See "The Rideau Canal and Contemporary Canal Construction Projects" in the following chapter of this report.


62 There appears to have been a great deal of confusion as to the anticipated cost of the Ottawa River canals prior to their construction being undertaken. The
Select Committee of 22 April 1831 reported the preliminary estimate for all of the canals was £16,740; but that sum must have been the preliminary estimate for the Grenville Canal alone on the strength of which the Treasury Board authorized construction to proceed in 1819. The provincial government of Lower Canada in the same year apparently debated a bill to appropriate £25,000 to commence the Ottawa canals and a further £10,000 per annum for 6 years to complete them, at presumably a total estimated cost of £85,000 for the four canals. (See Report of the Select Committee, 2 April 1831, British Parliament Papers, Vol. 6, p. 330.)

63 The Royal Staff Corps was an engineering regiment founded by the Duke of York, the Commander in Chief of the Army in 1799. Officers of the Royal Staff Corps served under the Duke of Wellington in the Peninsular War, and built the Royal Military Canal, between Winchelsea and Hythe in south England, as well as the Ottawa canals (R.F. Legget, Canals of Canada, Vancouver; Douglas, David & Charles, 1976, pp. 64-66). When the Royal Staff Corps was abolished in 1829, the Officers working on the Ottawa canals were placed under the authority of the Ordnance and presumably assimilated into the Corps of Royal Engineers.


65 PAC, MG13, WO44, reel B-1294, Vol. 19, p. 44, Treasury Minute, 2 February 1830. The Treasury Minute transposes two of the sums: viz. the Grenville estimate is reported as £59,100 and the Carrillon at £105,000; but the estimates were clearly the reverse, and have been so set forth in the text above.
66 Ibid., p. 32, Sir James Kempt to Sir George Murray, 12 February 1829. This package contained the plans and estimates prepared by Lt. Col. Du Vernet.

67 Ibid., p. 46, Lt. General Kempt to Sir George Murray, 12 February 1830. See also, ibid., p. 52, Kempt to Murray, 1 April 1830.

68 Ibid., p. 52, Col. Durnford to Lt. Col. Couper, 8 March 1830; and ibid., pp. 47-50, Durnford Committee, "Report and Estimate of the Total Probable Expense from the 25 April 1829 of forming the line of Canal at the Carillon Rapids, Chute à Blondeau and Grenville," [8 March 1830].

69 Ibid., p. 55, R. Byham, Secretary of the Ordnance, to Hon. J. Stewart, Treasury Board, 9 July 1830.


71 Ibid., reel B-1294, Vol. 19, p. 55, R. Byham to J. Stewart, 9 July 1830; and ibid., p. 58, Lt. Col. Henry Du Vernet, Report and Estimate of the probable Expense of constructing a Canal to turn the Carillon Rapids, as connected with a Feeder from the North River, 16 May 1830. See also Robert Legget, Ottawa Waterway: Gateway to a Continent, (Toronto: University of Toronto Press, 1975), p. 143.


73 Legget, Ottawa Waterway, pp. 136-43.

74 An adjustment has been made in calculating the cost overruns to enable a true comparison between the various estimates and the cost of the amount of work actually performed to be made. The total cost of the three Ottawa canals as of their opening to navigation in April 1834, was £312,009; but this sum included the
cost of the Royal Staff Corps establishment for five work seasons, 1829 through 1834, which was not included in either the Kempt Committee's estimate of November 1828, or the supplementary Du Vernet estimate of February 1829 for building the Rideau Canal scale locks. However, Col. Durnford calculated that it would cost £23,761 to support the two companies of the R.S.C. for four work seasons, 1829-32; and this figure has been augmented by 1/5 to cover the 1833 work season: viz. to £29,701. Thus, the total cost of constructing the canal works on the Ottawa canals, exclusive of the cost of the establishment, was £282,308 (£312,009 less £29,701).


Hugh G.J. Aitken, The Welland Canal Company, A Study in Canadian Enterprise, (Cambridge, Massachusetts: Harvard University Press, 1954), pp. 51, 75, 61-62, 68, and 85. The committee of engineers building the Welland Canal estimated in 1825 that it would cost £147,240; and this estimate was reproduced in the Smyth report of 9 September 1825. However, that estimate was apparently only for a canal from Lake Ontario as far as the
Welland River (see ibid., p. 83 and Aitken's footnote).


78 Jean Lindsay, The Canals of Scotland, (Newton Abbot, England: David & Charles, 1968), pp. 146-47. William Jessop, the consulting engineer on the Caledonian Canal project, estimated the cost at £474,500 in April 1825 (ibid., p. 145), but in 1805, the scale of the locks to be built was increased from 38 by 162 feet to 40 by 170 feet, which added £8,000 to the estimate (ibid., p. 146). Thus, the estimate for the scale of locks actually built was £482,500 in 1805 (£474,500 + £8,000).

79 Ibid., pp. 149-55.


81 Ibid., p. 156; and Samuel Smiles. Lives of the engineers, with an account of their principal works, comprising also a history of inland communication in Britain, (London: J. Murray, 1862), Vol. II, p. 417 and Smiles' footnotes.

82 The Bryce Committee believed that wood locks would "probably not cost 1/3 that of masonry locks" (PAC, M13, WO44, reel B-1294, Vol. 19, Report of the Committee, 22 January 1828, p. 139); whereas the committee of engineers who constructed the Welland Canal estimated that wood locks could be constructed "at 1/9 part of the expense of stone locks" (Captain Basil Hall, Royal Navy, Travels in North America in the years 1827 and 1828, [Edinburgh: Cadell & Co., 1829],
Vol. I, p. 218). The latter figure is probably more accurate as the Welland Canal engineers, most of whom had worked on America canal construction projects including the Erie Canal, were more familiar with both types of lock construction.

The state of the roads in the Rideau interior is aptly described in Jean S. McGill, A Pioneer History of the County of Lanark, (Toronto: T.H. Best Printing Co., 1970), pp.14, 22, 29, 31 and 118; Edwin C. Guillet, Early Life in Upper Canada, (Toronto: University of Toronto Press, 1969), pp. 519, 525-26, and 530; and H.R. Morgan, "The First Tay Canal: An Abortive Upper Canadian Transportation Enterprise of a Century Ago," Ontario Historical Society, Papers and Records, Vol. XXIX, Toronto: O.H.S., 1933, p. 104. Although winter road travel was comparatively much easier, it was still by no means easy in the narrow paths cleared through the deep snow. (See Douglas Library, Queen's University, Rev. W. Bell Diaries, Vol. 7, pp. 7-8.) The Rev. Bell describes the difficulties experienced by a train of sleighs moving a large number of Royal Sappers and Miners and their families along the Richmond Road to the interior of the Rideau in February 1830.


The swamp fever and ague which afflicted the Rideau Canal staff and workers was indeed malaria. (Bush, Builders of the Rideau Canal, pp. 25-27.)


89 PAC, MG13, WO44, reel B-217, Vol. 15, pp. 19-21, Captain Savage to Lt. Col. By, 6 September 1828; and ibid., John Webb, Director General, Ordnance Medical Department, to R. Byham, Secretary of the Ordnance, 30 November 1829, p. 35.


91 The symptoms and duration of the swamp fever are described in MacTaggart, Three Years, Vol. II, pp. 17-18, and 21.

92 Although the Ordnance, by a regulation of 17 April 1826 had provided that a stoppage, of £1 per day for every Foreman and artificer and 1d per day for every labourer, be placed on the pay of each man employed "on the cheque" by the Royal Engineer Department to provide for medical attention, medicines, and hospitalization for the men, as well as subsistence for their families, in the event of their being incapacitated through illness or accident, no provision was made for the care of workers employed by the contractors or the casual labourers hired by the Department on the Rideau. When the sickness struck, Lt. Col. By, on his own
responsibility, ordered the medical Officer, Assistant Surgeon Tuthill, to administer to all of the sick regardless of whether they were covered by the regulations or not; and thereafter ordered that the sick be admitted to the hospital at By Town and put on the charge of the Military Chest if they were not covered by the stoppages. In the winter of 1828-29, when Lt. Col. By discovered that a number of artificers and labourers, who had been wounded in blasting accidents, were suffering severely from frost bite as they lay in the rough log huts scattered around the various work sites, he also ordered that they be removed to hospital. Thereafter, By explained the situation to the Ordnance and requested authority to continue that course of action. The Ordnance replied in the affirmative to this as well as to By's suggestion that extra pay and an assistant medical Officer be procured for Mr. Tuthill to compensate for the added medical burden, and that permission be granted to hold back some of the monies due the contractors to pay for the medical supplies and hospitalization required for their workers. The casual workers who became ill or were injured, were carried on the accounts of the Rideau Canal project as there was no means of covering their medical expenses, and if left unaided, they would have inevitably died of neglect and exposure if not starvation. Lt. Col. By, of course, exceeded the Ordnance regulations in providing medical care and hospitalization for the workers employed by the contractors and the casual labourers, as well as a subsistence to their respective families, but was motivated by humanitarian considerations. Indeed, this concern was manifest from the very beginning of the project. When small-pox broke out in June 1827, Lt. Col. By procured vaccine ("vaccinating matter") and had Mr. Tuthill vaccinate
upwards of 500 of the labourers' children. (By's efforts to provide medical care for the workers and their families, and the regulations governing medical aid, are set forth in the following: PAC, MG13, W044, reel B-217, Vol. 15, pp. 36-37, Office of Ordnance, Regulations for making Medical Stoppages for Foremen, Artificers and Labourers, of the Civil Department at Foreign Stations, 17 August 1826; ibid., pp. 17-18, Lt. Col. By to General Mann, 8 September 1828; ibid., pp. 21-23, John Webb, Director General, Ordnance Medical Department, to R. Byham, Secretary of the Ordnance, 5 December 1828; ibid., p. 23, Webb to Byham, 19 December 1828; ibid., p. 35, Extract of a letter, Lt. Col. By to Col. Durnford, 7 August 1829; ibid., pp. 29-30, Lt. Col. By to General Mann, 19 January 1829; ibid., pp. 31-32, Memorandum on the remuneration to be granted Mr. Tuthill for his Attendance on the Sick Labourers, n.d. [28 August 1829]; ibid., pp. 33-35, Webb to Byham, 30 November 1829; and ibid., pp. 33-34, marginalia on the Webb letter, signed "M" [General Mann?], 4 December 1829.)

93 PAC, MG13, W044, reel B-1294, Vol. 18, Lt. Col. By to Col. Durnford, Document K, [14 January 1831], pp. 216-348. This document sets forth the amount expended at each site to clear the land so that the air might circulate freely. (Note: malaria was derived from the Italian "mala aria," bad aid.)

94 PAC, RG8, Series C, reel C-2619, Vol. 50, p. 6, Lt. Col. By to General Mann, 31 December 1829.


96 Ibid., reel C-2619, Vol. 47, p. 80, R. Routh to Commissary General Strachan, 20 January 1829; and PAC, MG13, W044, reel B-217, Vol. 15, Extract of letter, a letter, Lt. Col. By to Col. Durnford, 7 August 1829. Lt. Col. By also had to take on his establishment the
labourers working for the contractors who failed. These men were included in the figure cited.


Ibid., pp. 305, 329 and 336; and ibid., pp. 308-11.

Ibid., p. 482, Lt. Col. By to Col. Durnford, 24 January 1831. Among the Royal Engineers Establishment at the Isthmus, only one Clerk, Mr. Dunlop, and one member of the 7th Company of Royal Sappers and Miners, Private Simon Gibson, died of the fever during the 1830 sickly season. However, nearly all of the women of the Company and the children suffered severely with 4 women and 3 children dying of the fever. The rest of the deaths at the Isthmus were from among the labourers and their families (Ibid.).

It is not known how many men died of the ill-effects of the swamp fever during the construction of the Rideau Canal, as Lt. Col. By refused to gather statistics on the number of deaths prior to 1830 for fear of scaring off the workers. In 1834, Dr. Barker (Observations, p. 15) wrote that 500 labourers were reputed to have died of the fever at Kingston Mills alone; but this figure appears to be grossly inflated. However, from the partial returns available, it is evident that at the very least several hundred, perhaps as many as 500 men, died of the fever during the course of construction on the project as a whole.


Douglas Library, Queen's University, Rev. Bell Diaries, Vol. 6, February 1830, p. 176.

103 This distinction has been noted by numerous commentators from E.J. Barker (Observations on the Rideau Canal, 1834, p. 10) to Robert F. Legget ("The Jones Falls Dam on the Rideau Canal, Ontario, Canada, Transactions of the Newcomen Society, XXXI, 1958, p. 206).

104 James Brindley, the engineer on the Bridgewater Canal which ushered in the canal building era in Britain, believed that rivers were useful only as feeders for canals; and English canal engineers generally shunned rivers in constructing their navigations (See L.T.C. Rolt, Navigable Waterways, London: Longmans, Green and Co., 1969, pp. 35-36). Robert Fulton, the American engineer, also apparently argued in one of his works that it was better to construct a canal parallel to a river rather than render it navigable (See A.J.C., "Rideau Canal," Brockville Recorder, Vol. X, No. 20, 18 May 1820). John MacTaggart, who had worked on a number of British canal construction projects, believed that the method Lt. Col. By was using to construct the Rideau Canal was unique: "perfectly different from any other in the known world" (see MacTaggart, Three Years, Vol. I, p. 162, and PAC, MG24, E6, MacTaggart Collection, p. 23, John MacTaggart to Lt. Col. By, 5 September 1827).

105 Slackwater navigations, MacTaggart's belief to the contrary, were by no means unknown in the United States (See David Stevenson, Sketch of the Civil Engineering of North America, [London: John Weale, 1828], p. 282).

106 PAC, MG13, W044, reel B-1294, Vol. 18, Lt. Col. By to Col. Durnford, Document K, [14 January 1831], various lock site entries, and especially pp. 234 and 280. These costs were by no means insignificant. At one of
the smaller lock sites, Maitland's Rapids (Kilmarnock), £1224.8.0 had to be expended in pumping alone up to the close of December 1831. The contract rate for excavation work covered contingencies such as pumping and forming coffer dams (PAC, RG8, Series C, reel C-2619, Vol. 49, p. 15, Lt. Col. By to Lt. Col. Couper, 10 July 1829); but the costs, which proved to be far higher than anticipated because of the numerous springs encountered, were itemized in the Rideau Canal estimates indicating that Lt. Col. By may well have agreed to compensate the contractors for their inordinately heavy expenditures.

107 Ibid., reel C-2618, Vol. 46, p. 140, Lt. Col. By to Lt. Col. Couper, 30 November 1828. The Hog's Back dam was carried away in the spring of 1828 by a flood which turned the flank of the incomplete structure. The re-built dam was also badly breached by flood waters in April 1829. This second misfortune, however, was the result of frost having prevented the fill, placed in front of the dam during the winter of 1828-29, from settling properly rather than attributable to the incomplete state of dam. The dam had been raised sufficiently high to withstand the flood waters. (Lt. Frome, "Account of the Causes which led to the Construction of the Rideau Canal . . .," Papers on Subjects connected with the duties of the Corps of Royal Engineers, Vol. I, pp. 81-82.)

108 Heisler, The Canals of Canada, p. 13; and Canada-Ontario-Rideau-Trent-Severn Study Committee, The Rideau Trent Severn: Yesterday, Today and Tomorrow, (Toronto: Queen's Printer, 1971), p.14. Present day data has been cited for the Rideau Corridor in the absence of 19th century figures. The amount of precipitation and snowfall in the early 19th century may have differed somewhat from the cited figures as
climatic conditions have probably been altered by the clearing off of the forest cover.


111 In all fairness, it should be noted that Telford had to construct numerous tunnels and culverts to carry flood swollen mountain streams under the Caledonian Canal in addition to building "powerful sluices" to run off excess water entering the canal from the surrounding mountains (Smiles, Lives of the engineers, Vol. II, p. 415). However, Lt. Col. By's flood problem was much more serious as with the exception of one outlet at Whitefish Falls into the Gananoqui River, all of the flood waters had to pass down along and through the Rideau Canal which was the drainage system for the whole of the canal's hinterland.


113 Lt. E. Frome, R.E., "Account of the Causes which led to the Construction of the Rideau Canal, connecting the Waters of Lake Ontario and the Ottawa; the nature of the Communication prior to 1827; and a Description of the Works by means of which it is converted into a Steam-boat Navigation," Papers on Subjects Connected with the Duties of the Corps of Royal Engineers,
Lt. Col. By considered the works at Jones Falls, the high lift locks and the massive stone arched dam, to be "the boldest undertaking on the Rideau Canal" (PAC, MG13, W044, reel B-1298, Vol. 24, pp. 608-09, and p. 632, Lt. Col. By to Lt. Col. Fanshawe, 27 July 1833. 


116 PAC, RG8, Series C, reel C-2619, Vol. 48, p. 80, Lt. Col. By to Sir James Kempt, 25 April 1829. It is not surprising that the contractors were unfamiliar with the keywork construction used in building arched dams. The stone arched dams on the Rideau Canal, including the Jones Falls dam, were the first arched dams to be erected in North America (Norman Smith, A History of Dams, [London: Peter Davies, 1971], p. 178).


122 Op. cit., "Canal District Inspectional Report," 1853-54. The length of all of the various canal cuts made on the Rideau Canal is set forth in this report, and in a number of instances the width, generally 76 feet, and the depth, averaging 6 to 8 feet, of the excavations are recorded. MacTaggart, who left the
Rideau Canal project in 1828, states in his book (Three Years in Canada, 1829, Vol. I, p. 166) that the amount of canal excavation would not exceed 18 miles; but Lt. Col. By over the next four years was able to reduce that amount by more than one-half through having recourse to various expedients.

The depth of cutting that would have been required is set forth in PAC, RG5, Al, reel C-4614, Vol. 70, Clowes' Survey Report, 5 February 1825, pp. D-373-4-D373-8. The Bryce Committee in its report of January 1828, of course, had agreed that the dams Lt. Col. By proposed to erect represented a considerable savings over the canal cuttings proposed by Clowes, and especially so if the latter had to be carried through solid rock [as would have been the case].

MacTaggart, Three Years, Vol. I, p. 166.

PAC, MG24, E6, MacTaggart Papers, John MacTaggart to Lt. Col. By, 5 September 1827, pp. 13-14 and 23. See also A.J.C. "Rideau Canal," Brockville Recorder, Vol. X, No. 20, 18 May 1830. The decline in sickness attributable to the drowning of the malaria breeding swamps along the Rideau waterway is attested to by Dr. Barker (Observations on the Rideau Canal, 1834, pp. 18-19).


Ibid., p. 232; and ibid., Vol. 18, p. 40, Lt. Col. By to Lt. Col. Couper, 16 March 1829. For a description of how the booms were constructed, the materials used and cost of the same, see ibid., reel B-218, Vol. 16, "Report and Estimate of the Probable Expense of repairing the works damaged by the Floods in April 1847
along the line of the Rideau Canal," 24 July 1847, p. 325.


131 Ibid., p. 230. Although the government of the day may have doubted By's competence, that was by no means the case with the Ordnance. After By retired to his estate, the Ordnance continued to seek out his advice on questions relating to the operation and maintenance of the Rideau Canal and to act on it. (See for example, ibid., pp. 229-45).

132 Judith Tulloch, *The Rideau Canal, 1832-1914*, Manuscript Report No. 177, National Historic Parks and Sites Branch, Parks Canada, 1975. This report provides a history of the administration and operation of the canal during the period cited together with a commentary on the personnel and the repairs and/or structural changes carried out at the various locksites on the waterway.

133 This information has been culled from Tulloch, *The Rideau Canal, 1832-1914*, p. 58 and pp. 79-143. The 1836 flood was three feet higher than any previously known, and the 1847 flood was one foot higher than any previous inundation (ibid., p. 98), and the 1909 flood was the greatest recorded up to that time (ibid., p. 94). The damage inflicted by the 1847 flood is set forth in detail in PAC, MG13, WO44, reel B-218, Vol. 16, pp. 311-325, "Report and Estimate of the probable Expense or repairing the Works damaged in April 1847 along the line of the Rideau Canal," 24 July 1847.

In general lock repairs have been confined to replacing sills where required and in several instances the rebuilding of wing walls with new stone. Major rebuilding work on the locks has been the exception rather than the rule. With the exception of the Lower Brewer's lock, only three locks had to have a lock wall taken down and rebuilt during the 19th century; although in the early decades of the 20th century, at least four locks were taken down and almost totally rebuilt in keeping with the original design. (Culled from Tulloch, pp. 81-143.) More recently, several locks have had a concrete rendering placed over the surface of the lock walls where the stonework has spalled badly.

In 1921-22, the Department of Railways and Canals established a concrete plant at Brook's Bay on Lake Opinicon to manufacture concrete blocks for making repairs to the locks (Dominion of Canada, Annual Report of the Department of Railways and Canals, 1921-22; King's Printer: Ottawa). Subsequent annual reports indicate that several locks were totally rebuilt with concrete blocks, amongst them lock No. 7 (1923-24), lock No. 3 (1925), lock No. 10 (1927), lock No. 15 (1929), lock no. 5 (1930). With the exception of lock No. 10 at Hartwell's and lock No. 15 at Long Island, all of the concrete block rebuilding of locks appears to have been concentrated at the Ottawa locks which are known to have been built with inferior stone (See Annual Report of D.R.C., 1902-03). However, this experiment in the use of concrete cannot be regarded as a success because today these lock walls are all badly spalled and are in no where near as good a condition as the majority of the locks that had their stonework repaired in stone.

PAC, RG11, Vol. 183, file folder #54623, J.D. Slater, Superintending Engineer, Rideau Canal to T. Trudeau,
Secretary, Public Works Department, 21 August 1861; and ibid., Vol. 185, file folder #7463, J.D. Slater to F. Braun, Secretary, Public Works Department, 2 August 1869.

138 PAC, RG11, Vol. 183, letter # 54404, J.D. Slater to Trudeau, Secretary, Board of Works, 6 August 1861.


140 Previously in 1973-74, the three original combined locks at Smiths' Falls were twinned with the construction of a large single lock of 26 foot lift, by far the largest on the Rideau Canal. This lock differs from the original locks on the system in its appearance, scale, and method of operation. It is built entirely of reinforced concrete with hydraulically operated steel gates and valve mechanisms, and utilizes tunnels under the floors and orifices in the floor to fill and discharge the lock chamber. The water flow is controlled by a vertical plate valve, operated by an hydraulic cylinder on the entrance and exit to the tunnels. Hydraulically operated steel gates were installed on the Newboro lock in 1966-67, and hydraulically operated wooden gates on the Black Rapids lock in 1968; but otherwise the lock gates are of wood and manually operated using crabs that in many cases date from the canal's construction.

141 The high dams constructed at the Hog's Back and at Davis Mills are good examples of structures that today seem to be but part of the natural landscape of the locksite.

142 The Ottawa canals cost £1,476.4.6\(\frac{3}{4}\) to maintain in repair in 1839 (PAC, W044, B217, Vol. 16, W. Mulcaster to R. Byham, 3 December 1829, p. 245). The Lachine Canal was enlarged during the years 1843-49 at which time five new locks, 200 feet by 45 feet with 9 feet of water on the sills, were built at a total cost of $2,159,128 (PAC, RG1, E12, Vol. 3, p. 107, Col.
Phillpotts, First Report on the Inland Navigation of the Canadas, 1838). The three short Ottawa canals were rebuilt during the years 1873-1882 with large locks to match the enlarged Lachine Canal locks (Legget, Canals of Canada, p. 69).

143 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, n.p., Lt. Col. By to Lord Dalhousie, 14 January 1833.

144 PAC, MG13, W044, reel B-217, Vol. 16, p. 245, W. Mulcaster to R. Byham, 3 December 1839, and ibid., p. 251, S. Thomas to R. Byham, 7 January 1840. Revenue from tolls averaged, at this time, about £4,800 per annum, leaving an operating deficit of about £4,470 (ibid.). The Rideau was believed to be comparatively cheaper to maintain in repair than any other major contemporary North American canal (see Major V.A. George, The Rideau Corridor, 1832-1898, M.A. Thesis: Queen's University, 1972, p. 60).


146 Aitken, Welland Canal, p. 76; and Heisler, The Canals of Canada, p. 49.

147 Aitken, Welland Canal, p. 76; and Heisler, The Canals of Canada, pp. 74, 96, and 116. The locks of the various St. Lawrence canals, constructed over the years 1834-1848, were 200 by 45 feet with 9 feet of water on the sills to accommodate side-wheel steamers; as opposed to the Welland Canal, which when enlarged 1842-48, was equipped with locks 150 by 26½ feet with 8½ feet on the sills to pass sailing vessels and the new screw steamers (Heisler, The Canals of Canada, p. 116).

148 The Welland Canal was closed for repairs for 93 out of the 184 day shipping season in 1836 (Aitken, Welland Canal, p. 71).
Apparent much of the poor workmanship was a result of efforts to push the canal rapidly to a conclusion in the last 3 or 4 years; and the inopportune death of two highly competent superintending engineers in 1817 and 1818 respectively (See Hadfield, British Canals, p. 127).

In comparing the several canals in terms of their durability, the volume of traffic has not been taken into account; but of the canals under study only the Lachine Canal experienced a heavy usage in the years immediately following its opening. However, the frost of winter, ground and flood water pressures, soil instability, and the natural weathering and decay of the building materials used in construction are much more significant factors affecting a canal's durability than the relative volume of traffic; and all of these factors were as severe on the Rideau Canal as anywhere.

It is not possible to ascertain the number of men employed on the Rideau Canal project as their numbers fluctuated wildly during the course of construction and only partial enumerations were ever made. In October 1826, Lt. Col. By estimated that he would require a force of 6,000 men to construct the canal (PAC, RG8, Series C, reel C-2617, Vol. 42, p. 103, Lt. Col. By to Major Darling, 2 October 1826); but this total may well have not been realized. A sickness report of January 1831, cites the maximum number of men employed up to that time on each of seven lock sites on the Cataraqui section of the canal: a total of 1,265 men (PAC, MG13, WO44, reel B-1294, Vol. 18, pp. 481-82, Lt. Col. By to Col. Durnford, 24 January 1831); but this figures does not include the men that were employed on excavation work off the lock sites such as in the Cranberry Marsh,
and at Bellidore's Rifts and Jack's Rifts on the Cataraqui section. In 1829, as many as 80 men were employed at Jack's Rifts alone (ibid., reel B-217, Vol. 15, p. 35, J. Webb to R. Byham, 30 November 1829). Clearly then, close to 1,500 men were probably employed on the Cataraqui section of the canal which comprises seven out of a total of 23 lock sites. Allowing for roughly an equal number of men on the other sections of the canal, and making allowance for the fact that the maximum number of men at any given locksite was not reached at the same time, it is certain that upwards of 4,000 men were employed on the project during the period of peak activity from 1828 through 1831. By way of comparison, it is known that 750 men were employed on the 6 mile long Grenville Canal cut in 1822 (Douglas Library, Queen's University, Rev. W. Bell Diaries, Vol. II, p. 114, Entry of 6 October 1822).

Ordnance construction projects and the defeat of Wellington's Grant Strategy

1 Surveys were made and detailed plans and estimates were prepared for all of the recommended works during the years 1826-27 by the Royal Engineers sent out for that purpose, and some minor works were eventually undertaken in addition to the major works mentioned above. For example, bomb proof storehouses were built on St. Helen's Island. The estimates of the Royal Engineers were almost invariably in excess of Smyth's preliminary estimates, and some by a very substantial sum. A comparative listing may be found in J. Joseph Greenough, The Halifax Citadel, 1825-60: A Narrative and Structural History, Manuscript Report Number 154, N.H.P. & S. Branch, Parks Canada, DIAND, 1974, Vol. I, p. 26.


3 PAC, MG13, W055, reel B-1280, Vol. 1551 (7), pp. 6-7, Major General Smyth et al., North American Commissioners Report, 9 September 1825.

4 Lee, Structural History of Fort Lennox, pp. 186-187. For a glossary of fortifications terms, see J.J. Greenough, The Halifax Citadel, 1825-60: A Narrative and Structural History, Canadian Historic Sites, Occasional Papers in Archaeology and History, Ottawa, 1977, pp. 6-8. (Note: all references in the present work are to the manuscript version of the Greenough report.) In the absence of any figure for the actual cost of building Fort Lennox, and in view of the fact that two gun towers provided for in the 1825 estimate of £86,726 could not be erected because of soil conditions, David Lee (Structural History of Fort Lennox, p. 2, and Isle-aux-Noix: 1759-1870, Manuscript Report Number 40, pp. 37-38) infers that "probably that amount was not expended." However, in view of the time it took to complete the fort after 1825, the erosion problems, and past increases in the Fort Lennox estimate, that inference is suspect.


6 Steppler, ibid., p. 92.


8 Hitsman, Safeguarding Canada, pp. 118-119.

9 Ibid., p. 127.


13 Greenough, The Halifax Citadel, Vol. I, p. 26. The preliminary and the engineer's estimates for all of the projects are listed therein. Where the figures listed differ slightly from those in the original reports, as is the case with respect to the engineer's estimate for the Kingston fortifications and the total cost of Smyth's preliminary estimates, the figures cited in the text are from the original reports.


18 Ibid., p. 330.

19 PAC, RG8, Series C, vol. 40, reel C-2617, p. 221, Wilmot Horton, Memorandum relative to the Water Communication between Upper and Lower Canada, [10 November 1823].
20 Personal Communications, R. Legget to R.W. Passfield, 9 January 1980.


25 The Duke of Wellington formed a ministry on 9 January 1828, and on 26 January was appointed First Lord of the Treasury whereupon he resigned as Commander-in-Chief of the Army. By virtue of the latter position, he had been a member of both the Liverpool and the Goderich administrations. Earlier Wellington had resigned his positions as Commander-in-Chief of the Army and as Master General of the Ordnance when the Canning administration was formed; but he had been re-appointed to the former post when the Goderich administration succeeded that of Canning.

26 Sir Henry Hardinge, Minutes of Evidence before the Select Committee on Public Income and Expenditure, 24 March 1828, Second Report from Select Committee on Public Income and Expenditure, No. 420, Ordnance Estimates, Session 29 January - 28 July 1828, Great
No record has been found of the exact sums voted for the Fort Lennox and Quebec citadel projects in 1828, but £15,000 was voted for the Ottawa canals project in that year and £120,000 for the Rideau project (PAC, MG13, WO44, reel B-217, Vol. 15, p. 285, 26 July 1833, S. Thomas, Clerk, Office of Ordnance, "Statements of the Receipts and Expenditures on account of the Rideau Canal from 1826 to 31 December 1832;" and ibid., p. 294, 29 January 1834, S. Thomas, "Statement of the Sums voted by Parliament and of the Expenditures on Account of the Ottawa Canals from their commencement to the 31st December 1832."


Dendy, "the Strategic Importance of Kingston," p. 63.


See text above, p. 65.

See text above, p. 113.

Dendy, "The Strategic Importance of Kingston," pp. 63-64.

PAC, MG13, W055, reel B-2837, Vol. 1886, n.p., Committee Report, Major General Bryce to General Mann, 24 October 1829.

Ibid.

Ibid; and Dendy, "The Strategic Importance of Kingston," p. 65.

Dendy, "The Strategic Importance of Kingston," p. 66. If the Kingston fortifications had been constructed in keeping with the 1829 plan, "Kingston would have been the most strongly defended position in North America"

39 Ibid., pp. 66-67; and Saunders, A History of Martello Towers, p. 54.


41 Ibid., pp. 156-57.


43 Pamphlet, "Ste-Anne-de-Bellevue Lock," Parks Canada, Department of Indian and Northern Affairs, Ottawa, 1977.


46 Cost figure provided by John Grenville, Historical Research Officer, Old Fort Henry, Kingston, personal communication, 28 November 1979.

47 Dendy, "The Strategic Importance of Kingston," p. 80; and Saunders, A History of Martello Towers, pp. 54 and 56.

48 Ibid., p. 54.

49 Ibid., pp. 47-48.


51 Personal Communication, John H. Grenville, Historical Research Officer, St. Lawrence Parks Commission, Old Fort Henry, Kingston, Ontario, to R.W. Passfield, 28 November 1979. A plaque was erected to commemorate the construction of the Commissariat stores, and may well have been intended to mark the accomplishment of completing a project within the estimate as both the
estimate and the final cost are cited on the plaque (ibid.).


54 PAC, MG13, W055, Vol. 1551(7B), reel B-1280, pp. 154-55, Lord Hill, Commander-in-Chief of the Army, to Duke of Wellington, 5 March 1841; and Hitsman, Safeguarding Canada, pp. 141-42.

55 Hitsman, Safeguarding Canada, pp. 141-42.

56 PAC, MG13, W055, Vol. 1551 (7B), reel B-1280, p. 155, Lord Hill to Wellington, 5 March 1841.


59 Hitsman, Safeguarding Canada, pp. 133-34; Judith Tulloch, "The Rideau Canal. 1832-1914," National Historic Parks and Sites Branch, Parks Canada, Manuscript Report Number 177, 1975, pp. 6-7, 256; and National Historic Parks and Sites Branch, Department of Indian Affairs and Northern Development, Historical Assets of the Rideau Waterway, Ottawa, 1967, p. 33. At the height of the crisis in late 1838, Sir John Colborne, the Commander of the Forces in Canada, had 12,000 regular troops of all ranks and 21,000 provincial militia troops on continuous service under his command (Hitsman, Safeguarding Canada, pp. 136-37).

60 Historical Assets of the Rideau Waterway, p. 33. The three, stone masonry, lockmasters' houses constructed in 1838 did not have loopholes in the outer walls as did the defensible lockmasters' houses constructed at a
later date on the Rideau Canal. However, the three 1838 structures were considered to be defensible and presumably had loopholes in the heavy shutters which could be closed to cover the windows in the event of an attack.

61 In May 1838, large British reinforcements, comprising two battalions of Her Majesty's Foot Guards and two cavalry regiments arrived at Quebec, and were deployed across Canada with the 83rd Infantry Regiment being stationed at Kingston (Hitsman, Safeguarding Canada, pp. 133-34).


63 Ibid., p. 155. The invasion crisis was heightened somewhat by the almost simultaneous outbreak of the Maine-New Brunswick border dispute which witnessed a good deal of military manoeuvring on both sides of the border until it was resolved in 1839 (See Hitsman, Safeguarding Canada, pp. 137-38).

Lord Hill was directed by the Colonial Secretary, Lord John Russell, to obtain the views of Wellington on the Canadian defence question (op. cit., p. 154, Hill to Wellington, 5 March 1851). At that time, Wellington was out of government but still remained the predominate figure where military affairs were concerned. Shortly thereafter, in September 1841, he entered the new Conservative government of Sir Robert Peel; and the next year, following the death of Hill, Wellington was re-appointed to his former position as Commander-in-Chief of the Army.

64 PAC, MG13, W055, Vol. 1551 (7B), reel B-1280, pp. 144-49, Memorandum by the Duke of Wellington, 31 March 1841.

65 Ibid., pp. 145-46.

66 Ibid., pp. 156-57, Duke of Wellington to Lord Hill, 12 April 1841. Presumably the English steam tugs, as was
the case with the smaller Canadian river steamers, would have been able to pass through the 33 foot wide Rideau Canal locks, but not the 20 foot wide Lachine Canal locks. For example, the second steamer to be put on the Thames River, the sidewheeler packet Thames in service 1814 to 1835, had a deck length of 76.5 feet, keel length of 65.5 feet, and a breadth over the paddle boxes of about 25 feet. It had a burthen of 72 tons, with a 7 foot depth of hull drawing 4 feet of water and was capable of a mean speed of 6.2 knots (H.P. Spratt, *The Birth of the Steamboat*, Charles Griffin & Co.: London, 1958, pp. 95-97). Wellington obviously intended that the steam tugs should be dismantled in England, and shipped out to Canada for re-assembly on the waterways where they were to be employed.


71 Hitsman, *Safeguarding Canada*, p. 145. Neither the Whig government in which Lord John Russell was Colonial Secretary nor the Conservative government that succeeded it were willing to approve large scale expenditures on Canadian defence projects.

72 Dendy, "The Strategic Importance of Kingston," pp. 70-73; and Hitsman, *Safeguarding Canada*, p. 128. The Admiralty also apparently believed that Kingston was vulnerable to American encirclement which in wartime
would prevent equipment and supplies reaching there via the Rideau Canal (Dendy, ibid., p. 70). The Army commanders did not mention that possibility perhaps because they were confident of their ability to move troops in sufficiently large numbers and quickly enough, via the Rideau Canal, to meet and defeat any American attempt to cut the Rideau Canal communication.

73 Hitsman, Safeguarding Canada, pp. 126-28, and p. 112; and Dendy, "The Strategic Importance of Kingston," pp. 73-77.

74 Beattie, Gunboats on the St. Lawrence River, pp. 32-35; and Hitsman, Safeguarding Canada. p. 134.

75 Beattie, Gunboats on the St. Lawrence River, p. 37.


77 Beattie, Gunboats on the St. Lawrence River, p. 3.

78 Hitsman, Safeguarding Canada, p. 141.

79 Dendy, "The Strategic Importance of Kingston," p. 88; and Hitsman, Safeguarding Canada, p. 144. The U.S.S. Michigan was a sidewheeler 163.3 feet long, with a 27.1 foot beam, and a 9 foot depth. (Karl Kuttruff and David T. Glick, Ships of the Great Lakes, A Pictorial History, Wayne State University Press: Detroit, 1976, text of Plate 8. The draft of the U.S.S. Michigan was eleven feet.

The first steam warship ever constructed was the Demologos, launched at New York, 29 October 1814 under the name Fulton the First. It was designed by Robert Fulton, and intended for use in breaking the British blockade. The war, however, ended before it was ready for its first trial run on 4 July 1815 when it attained a mean speed of 6.35 miles per hour [sic]. The vessel
had twin keels, with a 16 foot diameter paddle wheel, 14 feet wide, in the center; and it was armed with 32 pounders. Overall the Demologos was of 2475 tons burthen, measuring 156 feet in length and 56 feet in breadth with a 10 foot draught (H. Philip Spratt, The Birth of the Steamboat, London: Charles Griffin & Co., 1958, pp. 97-98.

The first British built steam warship, the Rising Star launched on the Thames River on 5 February 1821, was built for private owners and intended for service in the Chilean Revolution. It made the first east-west crossing of the Atlantic by a steamship in 1821-22; but arrived in the Pacific too late to participate in the revolution. The vessel had three flat-bottomed hulls, with two internal paddle wheels, 13.5 feet in diameter and 7.5 feet wide. Of 428 tons gross register, the Rising Star was 123.5 feet long between perps. and 27.8 feet in breadth, with a draught of 5.5 feet, and was capable of a speed of 5 to 6 knots (Spratt, ibid., pp. 110-13).

The terms of the Rush-Bagot agreement of 1817 are set out in ibid., p. 114-15.

83 Saunders, Martello Towers, p. 53.
84 Ibid., p. 56.

86 Saunders, Martello Towers, p. 56; Lavell, "Fortifications at Kingston," p. 159.

87 Hitsman, Safeguarding Canada, pp. 145-46.

88 Saunders, Martello Towers, p. 57; and Hitsman, Safeguarding Canada, p. 145.

89 Ibid., p. 146.

90 Saunders, Martello Towers, p. 49.

91 Ibid., p. 57.

92 Lavell, "Fortifications at Kingston," p. 158.

93 Saunders, Martello Towers, p. 57.

94 Saunders, Martello Towers, pp. 57-74. Saunders' report reproduces original drawings, and provides a detailed description, of each of the new fortifications erected at Kingston in 1846-48.

95 Saunders, Martello Towers, pp. 61 and 65. All of the fortifications erected at Kingston ca. 1832-43, and in 1846-48, are extant today with the exception of the Market Place Battery. The latter was purchased, and demolished, by the Kingston and Pembroke Railway in 1885 to facilitate the laying down of track into their new Kingston station (W.S. Lavell, "The History of the Present Fortifications at Kingston," Ontario Historical Society, Papers and Records, Vol. XXXI, Toronto, 1936, p. 175).

96 Fort Wellington, near Prescott on the upper St. Lawrence River, was constructed during the War of 1812 (more specifically in 1813-14) to aid in the defence of the river communication with Upper Canada and was abandoned after the war. In the face of the threat posed by the Hunters' Lodges, the fort was re-built in 1838, and garrisoned with troops from February 1838 through to 1856, and again, at the time of the Fenian raids, in 1856 through to 1870. See David Lee, "Fort

97 Col. Holloway, Commanding Royal Engineer, Canada, to Major General Sir J.F. Burgoyne, Inspector General of Fortifications, 25 February 1846, extract reproduced in Canadian Historic Sites Division, Historical Assets of the Rideau Waterway, Ottawa, 1967, p. 34. The other main road into the Rideau interior from the St. Lawrence Front was the Brockville Road from Brockville to Perth which crossed the line of the Rideau Canal at Oliver's Ferry on Big Rideau Lake.

98 Col. Nicolls, Commanding Royal Engineer, Canada, to R. Byham, Secretary of the Ordnance, 30 July 1832, extract reproduced in ibid., p. 29.

99 Col. Holloway to Major General Burgoyne, 25 February 1846, ibid., p. 34. Lt. Col. By originally intended to construct Martello towers at a number of Rideau Canal locksites. See, for example, the vertical section of the Martello tower he proposed to construct at the Hog's Back (PAC, Map Division, VI/410, Rideau Canal, 1827, "Plan, Elevation and Sections of Works of the Rideau as proposed to be performed at the Hog's Back," John By, Lt. Col., R.E., 7 July 1827)


101 Col. Holloway to Major General Burgoyne, 25 February 1846, op. cit., p. 34.

102 For a description of how an abattis was constructed, see "Abattis" entry, pp. 31-32 of Great Britain, Corps. of Royal Engineers, Aide-Memoire to the Military Sciences, Part A, B, C, Vol. I, Dublin, May 1845.

103 Col. Holloway to Major General Burgoyne, 25 February 1846, op. cit., p. 34.

104 For an elaboration of Wellington's 1819 views, see text p. 11.
Following the completion of the Rideau Canal, the limitations placed on expenditures by Treasury Board forced the Ordnance to make use of the abandoned log cabins of the contractors for the accommodation of the lock masters and labourers at the various lock sites. Only three proper lockmasters' houses had been built while the canal was under construction: viz. the rubble stone masonry structures at Black Rapids, Long Island, and Kingston Mills where the respective contractors had accepted it. Col. By's offer to share the £300 construction cost 50/50 in return for being able to use the building so erected during the construction period. These buildings were not military structures, and so would have required loopholing to become so; and the other cut stone masonry lockmasters' houses: viz. the defensible lockmasters' houses erected in 1838 at Old Sly's, Clowe's and Nicholson's, also did not have loopholes in the outer walls. The latter, however, were considered to be defensible structures and probable had loopholes in the heavy window shutters and doors; and Col. Holloway now wanted to strengthen them by having their walls loopholed in keeping with the new Chaffey's lockmaster's house model.

Existing records show that all of the defensible lockmasters' houses were erected by 1852; but other than the one erected at Chaffey's in 1844 and the three erected in 1838 at Old Sly's, Clowe's and Nicholson's, the actual dates of construction have not been discovered. It would appear, however, that the remaining twelve lockmasters' houses were erected at
the same time as the Chaffey's structure or directly thereafter. Today, twelve of the original sixteen defensible lockmasters' houses constructed on the Rideau Canal are extant with only those at Smith's Falls detached lock, Edmond's, the Hog's Back, and By Town, having been demolished. Of the defensible lockmasters' houses extant, the best preserved is that at the Davis lock.

110 Photographs of the defensible lockmasters' houses at these three sites do not show any indication of loopholes on the outer walls.


112 Saunders, A History of Martello Towers, pp. 57 and 90.


115 Saunders, A History of Martello Towers, p. 75.

Quebec, next to Halifax, the major disembarking point for any British armies operating in North America, was also apparently viewed as an exceptional case warranting expenditures on permanent fortifications (ibid., p. 49).

There appears to be little doubt that Col. Nicholls, the Commanding Royal Engineer at Halifax who prepared the initial plans for the Halifax citadel and supervised the construction work undertaken prior to being relieved of that command in October 1831, was grossly incompetent both in the planning and organizing of that project. He left almost insuperable problems for his successor, Lt. Col. Richard Boteler who was transferred from Lt. Col. By's staff on the Rideau Canal to sort out the mess created by Col. Nicholls at Halifax. (See Greenough, The Halifax Citadel, 1825-60, Vol. I, pp. 82-105, and especially pp. 93-94.)

Lt. Col. By had refined that early £1,000 figure somewhat by 1828 when he was recommending that the large locks should be 150 by 50 feet with 5 feet of water on the sills. He apparently informed the Ordnance that such a lock would cost £7,007 to construct as opposed to £5,880 for the smaller 20 by 108 foot lock with 5 feet of water on the sills: viz. a difference of £1,127 per lock (Sir Henry Hardinge, Minutes of Evidence, 26 March 1828, p. 82. Great Britain, Parliamentary Papers, Reports from Committees, Vol. 5, 1828.


PAC' MG13, W055, Vol. 1551 (7B), reel B-1280, pp. 156-57, Duke of Wellington to Lord Hill, 12 April 1841; and Hitsman, Safeguarding Canada, p. 147.

Saunders, A History of Martello Towers, pp. 57, 75 and 90.


See Henry S. Tanner, *A Description of the Canals and Railroads of the United States comprehending Notices of all the works of Internal Improvements throughout the several States* (New York: T.R. Tanner & J. Disturnell, 1840), Reprints of Economic Classics, New York: Augustus M. Kelley Publishers, 1970, and especially p. 81, "A New Map of New York with its canals, roads and distances from place to place along with stage & steamboat routes"; and p. 145, "A new Map of Pennsylvania with its canals, rail-roads & distances from place to place along the stage roads."

Hitsman, *Safeguarding Canada*, pp. 144 and 146-147. Sir Richard Jackson died early in June 1845, and Sir Charles Metcalfe, the Governor General was dying of cancer. General Lord Cathcart succeeded to both positions and hence was the Governor General of Canada as well as the Commander of the Forces.

It was calculated that British forces could be transported from their embarkation point in England through to the head of Lake Ontario in from 18 to 20 days. The critical concern here, was to safeguard the Rideau Canal communication (Steppler, Quebec, The Gibraltar of North America?, p. 119).

Work had commenced on the enlargement of the Lachine Canal in 1843 as part of an effort by the Canadian provinces to construct a system of canals along the upper St. Lawrence River to enable large commercial steamboats to pass from Quebec to Lake Ontario, and eventually through an enlarged Welland Canal into the upper Great Lakes. The enlarged Lachine Canal was completed by 1848 with five locks 200 feet by 45 feet, with 9 feet of water on the sills; and the rest of the canals on the upper St. Lawrence (the Beauharnois, the Cornwall, and the Williamsburg canals) were completed by the fall of 1847 although one section, which had to be deepened was not completed until 1856 (John P. Heisler, The Canals of Canada, Occasional Papers in Archaeology and History No. 8, National Historic Parks and Sites Branch, Parks Canada, Ottawa, 1973, pp. 92-96). The completion of the upper St. Lawrence canals with locks larger than those on the Rideau navigation, and on a more direct route with considerably less lockage, marked the end of any hope that the Rideau Canal might develop into the major thoroughfare for the Canadian import/export trade.

Screw propeller driven steamboats were displacing paddle-wheelers on the Rideau Canal during the 1840s (Edward F. Bush, Commercial Navigation on the Rideau Canal, 1832-1961, National Historic Parks and Sites
Branch, Parks Canada, Manuscript Report Number 247, 1977, p. 24f.) When he first enunciated the tactic of arming commercial steamboats in time of war to serve as military transport vessels, Lt. Col. By had counted on the British dominating the carrying trade of the lakes in their own vessels, and consequently possessing a heavy predominance in steamboats over the Americans. However Montreal, even with the later construction of the more direct St. Lawrence canals never succeeded in dominating the trade of the American west as Lt. Col. By had hoped it would via the Rideau Canal. American railroad construction was one reason, amongst other factors (see W.T. Easterbrook and Hugh G.J. Aitken, Canadian Economic History, Toronto: Macmillan Co., 1956, pp. 294-95 and p. 300). As of 1841, the American's had an overwhelming superiority of steam vessels upon all of the lakes except Lake Ontario; and on Lake Erie had forty large steamers, capable of transporting 600 to 1,000 men, plying between the American forts and Detroit (PAC, MG13, W055, Vol. 1551 (7B), reel B-1280, p. 155, marginalia on Lord Hill to Wellington, 5 March 1841). In 1862, there were some 363 steamships, either paddlewheelers, propeller driven, or tugs on the Great Lakes; and of these, one hundred were Canadian (Guillet, Pioneer Travel, p. 116). Nonetheless, naval supremacy on Lake Ontario was the critical concern in transporting British troops; and even as late as 1890, Canadians had more ships and shipyards on Lake Ontario than the Americans. Elsewhere on the lakes, the Americans possessed fully 90 percent of the dry docks, shipyards and steamships (Alvin C. Gluek, "The Invisible Revision of the Rush-Bagot Agreement, 1898-1914," Canadian Historical Review, LX, December 1979, p. 468).

For a history of the economic impact of the Rideau steamboat navigation, see Major V.A. George, "The

Conclusion


2 Raudzens, ibid., pp. 110-11, 125, and 162-64.


6 The economic impact of the Rideau Canal has not been treated in the present study. It is extraneous to the argument being pursued, and has been developed at length elsewhere: viz. in Robert B. Sneyd, "The Role of the Rideau Waterway, 1826-1856," M.A. thesis, University of Toronto, 1965; and Victor A. George, "The Rideau Corridor: The Effect of a Canal System on a Frontier Region, 1832-1895," M.A. thesis, Queen's University, 1972.


8 These charges are made in Raudzens, "The British Ordnance Department in Canada, 1815-55," pp. 110, 143, 162, and 199. The quote is taken from p. 110.
Appendix A. Postcript to the Lock Size Debate: Steamboats on the Rideau Canal, 1832-1935, and the approved lock of June 1828

1 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, Lt. Col. By to Col. Ramsay, 7 December 1828, n.p.

Upon completion of the Kempt Committee Report, 28 June 1828, Lt. Colonels Fanshawe and Lewis prepared a report on the Kingston defences and then proceeded to the Niagara frontier to inspect its defences in keeping with their instructions from the Master General. Sir James Kempt, his duties performed, promptly returned to his post at Halifax (PAC, RG8, Series C, vol. 45, reel C-2618, Sir James Kempt, Montreal, to Earl Dalhousie, 3 July 1828, p. 206), and Dendy, "The Strategies Importance of Kingston", p. 63. The only drawing extant of the locks By initially intended to construct in response to the Kempt Committee's 28 June 1828 decision is: PAC, Map Division, VI/410, Rideau Canal, 1828, "Plan of the Approved Locks for the Rideau Canal," signed John By, Lt. Col., R.E., 8 July 1828.

4 See for example, Great Britain, Corps of Royal Engineers, Papers on Subjects connected with the Duties of the Corps of Royal Engineers, London: John Weale, 1839, vol. III, Plate 19, "Rideau Canal."

5 Canada, Department of Public Works, General Report of the Commissioners of Public Works, 1867, Ottawa: Queen's Printer, 1868, p. 64.


7 PAC, RG43, B4a, vol. 208, Charles Legge, Civil Engineer, to Hon. Roderick Matheson, President of the
River Tay Navigation Company, Perth, 18 September 1866, p. 432. Legge, also pointed out that the smallest of the locks on the Grenville Canal, which measured 107 feet by 19'-3" with 4'-6" of water on the sills, placed a limitation on the size of vessel operating on the Montreal-Kingston water communication (ibid); and this is generally cited as the factor controlling the size of vessel plying the Ottawa River-Rideau Canal system (for example, Legget, Ottawa Waterway, p. 143). However, even after the Ottawa River canals were enlarged with the building (1870-1882) of locks 200 feet by 45 feet with 9 feet of water on the sills, the size of vessel operating on the Rideau Canal did not increase to approximate the size of the Rideau Canal locks. It was clearly the nature or configuration of the Rideau waterway that limited, and continued to limit, the size of vessels using the canal both before and long after the small locks were eliminated on the Grenville Canal. Interestingly enough, the Kempt Committee in deciding in favour of locks of a size capable of passing steamboats 30 feet wide clear of the paddle boxes and 108 feet long, stated: "the Committee also think that larger boats would be inconvenient in some parts of the Rideau navigation" (PAC, MG13, WO44, reel B-1244, vol. 19, p. 28, Report of the Kempt Committee, 28 June 1828).

8 PAC, MG24, A12, Dalhousie Muniments, Section #3, reel A534, Lt. Col. By, Kingston, to Lord Dalhousie, 8 June 1832, n.p. The Union was put in service on the Rideau Canals as early as October 1831 when it passed up through the Ottawa locks and the locks recently completed on the canal as far as Merricks Mills (ibid.).

9 Edward Forbes Bush, Commercial Navigation on the Rideau Canal, 1832-1961, Manuscript Report No. 247, Parks Canada, Department of Indian Affairs and Northern
Development, 1977, pp. 23-30. The cited work comprises a comprehensive history of the operation of the Rideau Canal, and includes descriptions, and the names of the various types of vessels employed on the canal, as well as the operating facilities, and the nature and extent of the forwarding trade developed thereon.

10 Ibid, pp. 30-34.
11 Ibid, pp. 34-36.
12 Ibid, pp. 36-40, and p. 63.

13 This appears to have been the case with the river steamboats. The Accommodation, which was 85 feet long, had a breadth of hull of about 15 feet and was about 21 feet wide clear of the paddleboxes (H. Philip Spratt, The Birth of the Steamboat, London: Charles Griffin & Company, 1958, p. 85). The Ottawa-St. Lawrence river steamboats that were 30 feet wide over the paddle boxes, would have had a breadth of hull of 24 feet or less.


15 Edwin C. Guillet, Pioneer Travel in Upper Canada, Toronto: University of Toronto Press, 1966 (1st. ed. 1933), p. 107. The John By was originally intended to be a sidewheeler (Kingston Chronicle, 26 November 1831, cited by A.H.D. Ross, Ottawa: Past and Present, Toronto: the Musson Book Company Ltd., 1927, p. 68); but it was built as a sternwheeler (Patrick Shirreff, A Tour through North America, 1835, pp. 147-8, cited by Guillet, Pioneer Travel in Upper Canada, p. 107.)

16 Ibid. By way of experiment, a stern-wheeler, the Shannon, was put into service on the Ottawa River by the Ottawa and Rideau Forwarding Company during the 1830s (Legget, Ottawa Waterway, p. 145); but again this experiment was not followed up. A stern-wheeler, the
Iroquois, was built in 1832 to overcome the lesser rapids in the St. Lawrence River between the head of the impassable Long Sault rapids at Cornwall and Prescott at the foot of the navigable waters in the upper St. Lawrence River; and it apparently functioned quite well. (Ibid.) However, it may well have been a very small craft.

17 See Hunter, Steamboats on the Western Rivers, pp. 96-97, and 612-613.

18 Bush, Commercial Navigation on the Rideau Canal, p. 63. Not only were stern-wheelers not introduced onto the Rideau Canal at a later date, but the one stern-wheeler built for service on the Rideau Canal, the John By, was soon removed to Lake Ontario where as early as 1835, if not before, it was carrying passengers between York and Hamilton and perhaps elsewhere on the lake. (Guillet, Pioneer Travel in Upper Canada, p. 107).


20 Ibid, p. 24. The general statement as to hull widths is based on information found in this report.

21 Lt. Col. By may well have come to the realization that the river channel required straightening in a number of places if the large lake steamboats of 130 feet by 48 feet with a 8 foot draught were to ply his proposed large lock navigation. In writing to Lord Dalhousie after the 134 by 33 foot lock had been decided on, By commented that: "the lock they have proposed is a very good one and will save me a great deal of trouble" (PAC, MG24, A12, Dalhousie Muniments, Section 3, reel A534, Lt. Col. By to Lord Dalhousie, 14 July 1828, n.p.). Whether intentional or not, Lord Dalhousie was apparently not to be informed of By's active role in determining the dimensions, or at least the length, of the approved lock.
22  PAC, MG24, A12, Dalhousie Muniments, Section No. 3, reel A534, "white or yellow Pine", n.p., n.d.
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B Lachine Canal
C Vaudreuil Lock
D St. Lawrence Military Canals
E Erie Canal
F Welland Canal (under construction)
G Dundas Street
H Yonge Street
Lt. Col. John By, Royal Engineers. (Public Archives of Canada.) John By was born in London, England, on 10 August 1779 the son of a customs official. Following his graduation from the Royal Military College, Woolwich, By was commissioned a second Lieutenant in the Royal Artillery on 1 August 1799 and in December of that year transferred to the Corps of Royal Engineers. During a tour of duty in Lower Canada 1802-1811, he supervised the enlargement of a batteaux canal, the Cascades Canal, on the upper St. Lawrence River and the construction of four Martello towers at Quebec. Following service in the Penninsular War under the Duke of Wellington in 1811, Captain By was placed in charge of the Royal Gunpowder Mills in England until August 1821 when he was retired on half-pay. While on active duty, Captain By had displayed a keen interest in bridge truss design. When at Quebec, he and Jean-Baptiste Duberger, a draftsman-map maker of the Corps of Royal Military Surveyors and Draftsmen, worked in their off duty hours and at their own expense to build a detailed scale model of the town and citadel of Quebec. In March 1826, Lt. Col. By was recalled from retirement to superintend the construction of the Rideau Canal, and on its completion in the fall of 1832, he returned to England to settle on his estate in Sussex. He died on 1 February 1836 after a long period of illness brought on by his exertions in constructing the Rideau Canal.
Batteaux on the upper St. Lawrence River. (Public Archives of Canada, Anonymous watercolour, n.d., C-40333.) During the War of 1812, batteaux were the primary mode of transport between Montreal and Kingston on Lake Ontario. The batteaux were organized in brigades at Lachine where the goods transported overland from Montreal were loaded for passage upriver. Each batteau had a crew of four and a pilot, and was equipped with an anchor, four oars, and six setting poles shod with iron, for working the batteau up through the several extensive rapids of the upper St. Lawrence. Where the current in the rapids was particularly strong, the batteau often had to be lightened and its cargo portaged while the batteau was pulled up through the rapids by means of a tow rope pulled by members of the crew or a yoke of oxen. Each batteau carried a sail, and once the boat passed Prescott at the head of the Long Sault rapids, the crew were able to sail the rest of the way to Kingston.
A batteau at Upper Canada Village, Morrisburg, Ontario. (Photo Upper Canada Village 1979.) The batteaux in use on the upper St. Lawrence varied in size and detail of construction, but were generally flat-bottomed skiffs, pointed at both ends, and roughly 30 to 40 feet long and 6 to 8 feet wide. They were capable of carrying 5 tons of freight with a draught of as little as 20 inches, and the flat bottom rendered them particularly adept at riding up over turbulent waters thereby reducing their drag when being towed up through rapids. The batteaux crews were mostly French Canadians recruited from the parishes around Lachine.
H.M.S. Lugger gunboat Queenston, 1813. (Upper Canada Village Files, provenance unknown.) The two masted, lug rigged, gunboat Queenston built at Kingston, Ontario, in 1813 for service on Lake Ontario and the upper St. Lawrence, was one of a smaller class of gunboats. It was 48 feet in length, with a 12 foot beam, and a 7 foot depth of hold, and probably drew 4 feet or less of water. It was armed with a single long 24 pounder on a swivel amid ship. During the War of 1812, gunboats were found to be particularly well suited for protecting convoys of batteaux moving crucial military supplies and ordnance upriver to Kingston.
Hull details of H.M.S. Axeman gunboat, 1815. (Public Archives of Canada.) Toward the close of the War of 1812, gunboats were being constructed along the lines of the Axeman shown here. The gunboats had been increased in length to 60 feet or more, and in breadth of beam to 16 feet, with the depth of hold reduced to about four feet. These gunboats weighed as much as 56 tons deadweight, but drew only three feet of water. Each was equipped with a sail, and anywhere from 22 to 26 oars manned by a crew of 38 sailors. By 1814, the gunboats were generally armed with two guns: a 25 pounder long gun on a pivot and a 32 pounder short range carronade. The Axeman as shown carried two long guns and a carronade. The 20 foot by 108 foot locks that Lt. Col. By was initially ordered to build on the Rideau Canal were intended to enable gunboats, and Durham boats, to circulate freely between Montreal and Kingston via the Rideau route.
Draught of the Jemmy, John Bost on the 12th of April, 1777, Capt. John Bost, Master. Length 61 feet, Beam 14 feet, Depth 10 feet, Draught 7 feet 6 inches.
Gunboats and Frigates in action, Lake Champlain, 1814. (Public Archives of Canada, H. Reinagle drawing engraved by By Tanner, n.d., Photo C-40993.) In addition to convoy duty, gunboats were used in combined military-naval operations during the War of 1812 to protect the batteaux transporting troops, and to provide a covering fire at close range for troop landings. They also occasionally used their greater manoeuvrability to attack larger warships. The engraving shows gunboats in action at either extremity with sails either raised or furled. Each gunboat was capable of carrying 40 soldiers in addition to its crew of 38 sailors.
MacDonough's Victory on Lake Champlain.

And Defeat of the British Army at Plattsburg by Genl. MacQuar, Sept 11th 1814.
Hull plan of a Durham boat. (Public Archives of Canada C-108018.) Durham boats were introduced onto the upper St. Lawrence from the United States ca. 1809, and after the War of 1812 rapidly overtook the batteaux as the main vessel of commerce on the river. The Durham boats possessed not only the light draught characteristics of the batteaux but had a superior sailing quality and a much greater tonnage capacity (8 tons upstream, 35 tons downstream). The Durham boats were basically flat-bottomed barges with rounded bow and stern, some 60 feet long with a 9 to 13-1/2 foot beam, and 2-1/2 foot depth of hull, and drew only 18 to 28 inches of water. The Durham boats had a single mast with a long boom and sloop sail. When not under sail, the boats were propelled by crew members setting poles against the river bed and pushing as they walked along the gangway on either side of the open hold from the bow to the stern.
A modern artist's depiction of a St. Lawrence River Durham boat. (Public Archives of Canada, C-1096.) This depiction of a Durham boat in the locks at Coteau du Lac in 1781 is an anachronism as Durham boats were not employed on the St. Lawrence until ca. 1809. Moreover, the scale of the drawing is all wrong as the gates of the locks at Coteau du Lac in 1781 had a clearance of 7 feet 6 inches which would have been insufficient to pass Durham boats with their breadth of beam anywhere from 9 to 13 1/2 feet, and the length of a Durham boat, upwards of 60 feet, was totally out of keeping with that of the boat depicted. There is also no mast in evidence for the sail carried by Durham boats. However, the general configuration is that of a Durham boat. The Durham boat when fully loaded rode exceptionally low in the water, and was capable of carrying 270 barrels of flour as opposed to the 35 barrel capacity of the average batteau. Note: the canvas canopy put in position when passengers were being carried, and the cleats on the walking boards along either side of the open hold.
THE FIRST ST. LAWRENCE CANAL—1781

Caption: "Comprising the St. Lawrence—Captains Ely and White, Builders of Erie Lock Canal in North America of Canada the East"

From the original painting by Rex Wrobel for the Canadian National Exhibition of Canadianiana and Antiques.

DESCRIPTION OF PRINTING UNDER CALENDAR PAGE (One thousand)
The Durham boats in use on the St. Lawrence were of approximately the same length but appear to have been somewhat wider than their American progenitors with a flatter bottom and more nearly vertical sides more in keeping with the design characteristics of a barge by which name they were sometimes known on the St. Lawrence. The flat bottom of the St. Lawrence Durham boats, as with the batteaux, was probably adopted to reduce the draft of the boat and facilitate its being pulled up through the rapids of the upper St. Lawrence River. Durham boats were designed as early as 1750 by Robert Durham of Pennsylvania and in modified forms came into widespread use on American waterways thereafter. The crews of the early Durham boats on the St. Lawrence were for the most part American.
The First Raft down the Ottawa River, 1806. (C.W. Jeffreys, watercolour, Public Archives of Canada, C-73702.). This drawing depicts Philemon Wright of Hull taking his first raft of timber down the Ottawa-St. Lawrence rivers to Quebec in 1806. What is depicted is technically a "crib" which on the Ottawa were approximately 25 feet wide by 100 feet long. Once the rapids were passed, a number of cribs were lashed together to form gigantic rafts on which sails were often hoisted to propel them along the broad expanses of the river. The basic unit of the rafts built on the St. Lawrence was a "dram." Drams were about 33 feet wide by 100 feet long and of a much more sturdy construction. Given the importance of the timber trade to the economy of the Canadas, Lt. Col. By was quick to point out that the large 50 by 150 foot locks that he wished to construct on the Rideau Canal, and other Canadian canals under construction, would have enabled the cribs and drams to pass through the locks and avoid having to risk being torn apart or severely damaged in the rapids. This was not the case with the 20 by 108 foot gunboat locks that the Ordnance had ordered to be constructed on the Rideau and the Ottawa River canals.
The Frontenac steamboat. (John Ross Robertson Collection, Metropolitan Toronto Public Library.) The
Frontenac, launched at Ernesttown, Upper Canada, in September 1816 was the first steamboat built for service
on Lake Ontario; and it is representative of the type of steamboat that Lt. Col. By proposed to arm in the event
of war and use to transport troops, ordnance and supplies quickly to any point on the Upper Canadian
frontier threatened by invasion. The Frontenac measured 170 feet along the deck, 150 feet along the keel, and
had a 32 foot breadth of beam exclusive of the paddles. It drew 8 feet of water when fully loaded. The
steamboats built for service on the Great Lakes immediately thereafter, and the steamboats already in
service on the lower St. Lawrence were slightly smaller. For example, John MacTaggart found that two of the
larger steamboats on the lower St. Lawrence ca. 1826, the Lady Sherbrooke and the Chambly, measured 145 foot
by 50 feet clear of the paddles with a 10 foot draught, and 142 feet by 50 feet clear of the paddles with a 6
foot draught, respectively. The large 50 by 150 foot locks with 10 feet of water on the sills, that Lt. Col.
By recommended for construction on Canadian canals was calculated to enable all but one or two of the very
largest Great Lakes steamboats to circulate freely between the upper lakes and Quebec via the Rideau
route.
Lt. Col. By was anxious that steamboats, which he observed were rapidly superseding the sloops and schooners on the lakes, should be able to circulate through the Canadian canals, and to that end, he discussed with Montreal shipbuilders the practicability of constructing steamboats with the paddles on either side of the rudder. This would have reduced the clear width of the smallest of the river steamboats sufficiently to enable them to pass through the 20 foot wide lock in the event the Ordnance refused to authorize an enlargement in the locks to be constructed.
Model of the frigate H.M.S. Princess Charlotte. (Photo and scale model by W. Arnould, Ottawa.) The frigate H.M.S. Princess Charlotte was launched at Kingston Naval Yard in April 1814 in time for service in the War of 1812, and was armed with 24 long 24 pounders and 16 short 32 pounder carronades. It was 121 feet long, with a 37 foot breadth of beam, and probably drew upwards of 8 feet of water when fully armed and ballasted. This was the size of warship that Lt. Col. By recommended should be constructed in the security of the Ottawa River at By Town and towed out through the proposed large lock Rideau Canal navigation for service on Lake Ontario.
Plan and section of the 33 by 134 foot lock approved by the Kempt Committee in June 1828. (Public Record Office, London, England.) The lock design shown here was used in constructing the Rideau Canal locks. Gate sluices and wooden sills were used only on the lower end of single locks or the lower end of the bottom lock in a flight of locks where both the sill and the sluice valves were continually under water. These and other features of the lock design including the use of counterforts, inverted arch floors where the lock did not rest on bedrock, and the stop log grooves at either end of the lock to facilitate its being dewatered for repairs, were standard practice in contemporary lock design. The approved lock chamber with 5 feet of water on the sills was sufficiently large to pass the smallest of the river steamboats as well as timber rafts and the longest of the spars intended for the Royal Navy; and as such it served to realize most of the objectives Lt. Col. By had in mind when he first advocated that the Rideau Canal should be constructed as a large lock steamboat navigation.
Plan of the Line of the Rideau Canal, July 1830.

(Public Record Office, London, England.) When construction commenced on 21 September 1826, Lt. Col. By was under orders to construct the Rideau Canal by means of positioning locks in canal cuts excavated so as to circumvent the numerous rapids of the Rideau and Cataraqui rivers in keeping with the plan of construction proposed by Samuel Clowes in February 1825. On his own initiative, Lt. Col. By decided to canalize the river system by grouping locks beside high dams which were to be constructed so as to flood out the rapids and turn the Rideau Canal into a slackwater navigation. This type of navigation was by no means unknown to the Ordnance, but the military engineers who approved By's plan were unaware of any slackwater navigation where dams were employed as extensively as on the proposed Rideau navigation or raised to the uncommon heights contemplated. In all Lt. Col. By constructed 23 major dams and 17 extensive embankments, in addition to 23 waste weirs and 47 masonry locks, and among the arched masonry keywork dams constructed, the four highest ranged from 18 to 62 feet in height and were from 176 to 350 feet long along the crest.
17 Section of the Rideau Canal, July 1830. (Public Record Office, London, England.) In constructing the Rideau Canal navigation, Lt. Col. By overcame a total difference of elevation of 449 feet 0-7/8 inches measured from the level of the lower sill of the river locks, some 6 feet below the low water mark, at the Entrance Valley and Kingston Mills. This consisted of an initial difference of elevation of 286 feet 5-7/8 inches on the Rideau and 158 feet 1 inch on the Cataraqui, but was increased to 290 feet 11-7/8 inches and 162 feet 7 inches, respectively when the summit level was raised 4 feet 6 inches to effect a corresponding reduction in the rock excavation at the summit isthmus. The total difference of elevation was overcome by means of 47 locks grouped at 22 locksites scattered along a 119 mile stretch of the 123 1/2 mile long By Town to Kingston navigation.
The steamboat Pumper at Kingston Mills, 1829-1832. (Detail of T. Burrowes sketch no. 72, Provincial Archives of Ontario.) The steamboat Pumper was launched at Kingston in July 1829 by Robert Drummund the contractor for Kingston Mills locksite. It was 80 feet long, with a 15 foot beam, and a 6 foot depth of hold, and was powered by a 12 horsepower engine. The Pumper was used to keep water out of the coffer dam at Kingston Mills, and was the only steam pump in use during the construction of the Rideau Canal. Upon the completion of the canal, the Pumper renamed Rideau for the occasion carried Lt. Col. By and other dignitaries on the inaugural voyage from Kingston to By Town, 24-25 May 1832. Thereafter, the boat was employed in carrying passengers and towing barges between Kingston and By Town. Note the walking beams and lift arms connecting the steamboat engine with the pistons of the cylindrical pumps inside the coffer dam, and the masonry details of the lock under construction.
Plan of Long Island Rapids locksite, May 1828.
(Dalhousie Muniments, Scottish Record Office, with the
permission of The Earl of Dalhousie.) This is one of a
complete series of locksite plans that Lt. Col. By had
prepared by 5 May 1828 to inform the Commander of the
Forces, Lord Dalhousie, of the layout of the works that
had been contracted out at each locksite, the work to be
done there, and the estimated cost of the same. The
layout shown here is typical of the slackwater system of
navigation that Lt. Col. By proposed to construct with a
high dam being erected to flood out the rapids and form
a long stillwater extending upstream at a navigable
depth to the base of the next locksite, with locks being
grouped to the side of the dam, and embankments
constructed where required to hold the water at the
required depth. The saw mill shown pre-dated the canal
construction and had to be removed. Note that the high
arched dam was initially designed, as elsewhere on the
Rideau, to function as an overflow dam and eliminate the
need for waste weirs.
Sketch of Long Island locksite. (William Clegg, Public Archives of Canada, C-1205.) In the spring of 1829, the force of the flood waters flowing over the several low dams constructed on the Rideau to that date, caused considerable damage to the rear of the dams and convinced Lt. Col. By of the need to abandon the overflow dam concept in favour of constructing waste weirs and raising the height of the dams to prevent water flowing over them. The modifications made at Long Island, are typical of the changes made at all of the locksites where there was a significant difference of elevation between the waters above and below the proposed dam. At Long Island, the high arched masonry dam was raised from 29 feet, the height at which the water was to be maintained, to 31 feet, and a waste weir was constructed upstream of the dam in an artificial cut which enabled the surplus water to flow off into a snie, Mud Creek, which ran parallel to the Rideau River at this point. The locks, of course, were constructed 33 feet wide, instead of the 20 foot width initially projected, and the arched dam was extended in length as well as height. The two embankments proposed in the May 1828 plan were replaced by a single 300 foot long embankment extending directly upstream from the west abutment of the arched dam to the high ground of the river bank where the waste weir channel was cut through to Mud Creek.
Plan and Sections of the Waste Weir at Long Island. (Public Record Office, London, England.) Many of the 23 waste weirs that Lt. Col. By was forced to construct on the Rideau Canal were of a substantial size and capacity, and constructed of either rock filled timber cribs or cut stone masonry. Of the waste weirs constructed, only the Long Island weir, built in a cut made through blue clay, suffered from heavy erosion and proved difficult to maintain. The original masonry weir, erected by the contractors Phillips and White, was swept away in a flood of 8 June 1836, and replaced by the timber crib weir shown. The plan and sections show the size of the waste weir, 116 feet wide and 23 feet high, as well as the details of construction of a timber crib weir with timber bents mounted on the top of the base to hold the stop logs used to control the water level.
22 The Lock and Waste Weir at Chaffey's Mills, 1833.
(Thomas Burrowes, Sketch No. 44, Provincial Archives of Ontario.) The masonry weir shown here is of a conventional design with squared stop logs used to regulate the water level. Crabs were later added to the waste weir to lift and lower the stop logs. At Chaffey's Mills, the waste weir was placed in a snie passing through the bedrock and the lock walls were raised on the levelled, solid bedrock, floor of the river. The lock has a 10 foot 2 inch lift with a very high guard of 6 feet 6 inches to place the coping of the lock well above the level of Indian Lake above. The construction of lock walls with high guards, and upper gates of a matching height, prevented flood waters overflowing the lock and eliminated the need for a guard lock. Note the two pairs of crabs on either side of the lock at the upper gates and the single pair of crabs at the lower gates. At the upper gates, one pair of crabs was employed to operate the wall face valves on the tunnel sluices in the wall around the gates, and the other pair of crabs worked the floor chain system used to open and close the gates. At the lower gates, the single pair of crabs was used to operate the floor chains used for opening and closing the gates; and the sluices were placed in the gate with each valve being operated by means of a rack and pinion mechanism at the top of the lock gate. This was a standard arrangement in canal lock construction with tunnel sluices employed at the upper gates and gate sluices in the lower gates of a single lock.
Jones Falls lockstation. (William Clegg, Public Archives of Canada, C-1219.) Lt. Col. By considered the works at Jones Falls to be the boldest undertaking on the whole of the Rideau system. Here he had a 62 1/2 foot high, arched masonry dam (seen in the center background on either side of the house on the knoll) to block up the river valley and placed four locks in a natural snie commencing high up on the west side of the river valley. Initially Lt. Col. By planned to construct 6 locks of a standard 10 foot lift to overcome the approximately 59 foot difference of elevation; but the configuration of the terrain rendered this impossible barring an enormous expenditure for forming foundations. Consequently, he was forced to reduce the number of locks and adopt dangerously high lifts, for the 33 foot wide locks, of 15 feet 2 inches on the detached lock, and of 15 feet, 15 feet, and 13 feet on the three flight locks respectively. The gates were also reinforced to enable them to better resist the increased water pressure. The detached lock was given a guard of 5 feet over the level of the water backed up by the dam, and a waste weir channel (hidden from view) was cut through to the rear of the house on the center knoll, to enable the basin to be drained. The water level above the Jones Falls dam was controlled by the waste weir upstream at Morton, the Whitefish dam, which passed surplus water down into the Gananoque River system.
James Falls
Station No. 19 - 97 3/4 miles from Brampton
The Great Dam at Jones Falls. (Thomas Burrowes, Sketch No. 53, Provincial Archives of Ontario.) The great arched dam constructed at Jones Falls was unique in many respects. At 62 1/2 feet in height, and 350 feet in length measured along the crest, it was by far the highest dam in North America at the time of its construction in 1828-31, and with the exception of a single dam, an arched masonry dam constructed in Spain in the 17th century, was of an unprecedentedly high length-to-height ratio. It also shared, with the other masonry arched dams erected on the Rideau Canal, the distinction of being the first arched masonry dams constructed in North America. The arched masonry dams on the Rideau system were also unusual in that the masonry blocks were set in vertical, rather than the conventional horizontal courses, and in the fact that a clay puddle wall or core was placed in the dam against the masonry work.

The Jones Falls dam was built in a rocky gorge 138 feet wide at the bottom sloping out to roughly 300 feet at the top. The masonry of the dam constructed in that gorge was of arched keywork 27 1/2 feet thick at the base and battered on both sides towards the top. The keywork consisted of large 6 foot by 4 foot by 18 inch hammer dressed stone blocks laid on end so as to break joint all the way up. A 2 foot thick puddle wall was placed against the upstream face of the masonry with a clay and stone fill approximately 25 feet wide at top set against the clay puddle wall so as to slope out under the water backed up by the dam.
The Great Dam at Jones' Falls; from the west end.
The Narrows lockstation. (William Clegg, Public Archives of Canada, C-1215.) At the narrows of Rideau Lake, Lt. Col. By constructed a dam 427 feet long and 10 feet in height to raise the level of the upper part of Rideau Lake 4 1/2 feet to reduce by the same amount the difficult rock excavation on the 1 1/2 mile wide summit isthmus where sickness was rife. This deviation from the original plan of deeping the channel through the shallow waters of the Narrows, also required the construction of a lock and waste weir at the Narrows, and a lock at the far end of the canal cut through the isthmus as well as a total of 758 feet of embankment of roughly 5 foot height to maintain the water at the higher level. Note the blockhouse at the Narrows lock which is of the same design as the blockhouses Lt. Col. By had constructed at Newboro and Kingston Mills, and somewhat smaller than the blockhouse constructed at Merrick's Mills.
The sternwheeler John By. (John Ross Robertson Collection, Metropolitan Toronto Public Library.)

Robert Drummond, the contractor for Kingston Mills, had the John By constructed at Kingston for service on the Rideau Canal. Initially, the boat was intended to be a sidewheeler of 110 foot length, with a 26 foot beam, and 30 foot width over the paddles, and an anticipated draught of 3 1/2 feet. During construction, it was converted to a sternwheeler, and fitted with a 75 horsepower engine made by Henderson and Bennett of Montreal. The John By was probably intended to carry Lt. Col. By and his party on the inaugural voyage through the canal, but was launched too late for that purpose; and the vessel once launched drew too much water to ply the Rideau route. The John By was the only sternwheeler designed for service on the Rideau Canal despite Lt. Col. By's earlier interest in developing a design for a sternwheeler to ply the canal; and it proved to be a very unwieldy vessel. It was employed on Lake Ontario for a number of years, and was one of the first steamships on the lakes to have a high pressure engine.
27 Steamboat towing Durham boats past the Fort Henry redoubt, Kingston, 1839. (H.F. Ainslie, Public Archives of Canada, C-510.) This watercolour shows how Durham boats, loaded with freight, were towed on the Rideau Canal in the years immediately following its opening. The sidewheeler shown is typical of the design of the small river steamboats that the Kempt Committee had in mind when the decision was made to construct the Rideau Canal with locks 33 feet by 134 feet with a minimum of 5 feet of water on the sills: viz. steamboats 108 feet long and 30 feet wide clear of the paddles and drawing upwards of 4 feet of water. Note the newly constructed Fort Henry redoubt, and the branch ditch extending down to the waters edge on the other side of the naval dockyard peninsula. The advanced sea battery is also partially visible to the right; but the buildings in between have yet to be demolished to make way for the casemated commissariat stores constructed in 1841-43 to connect the Fort Henry redoubt and the advanced sea battery.
The Davis mill locksite. (T. Burrowes, Sketch No. 49, Provincial Archives of Ontario.) The two barges shown are of the type that succeeded Durham boats for hauling freight on the Rideau Canal within a decade of its opening; and they, as was the case with the Durham boats before them, were towed by the steamboats. At Davis mill rapids, the lock was constructed in the river channel with a dam built across to the far bank to raise the water level; and a waste weir channel, to the far left circling the rocky knoll on which the house is perched, was cut and a weir constructed therein to control the water level. Note the altered position of the crabs for operating the lock gates in conjunction with the curved balance beams which were added to the lock gates of many of the Rideau Canal locks as part of an on-going effort during the 1830s to convert the lock gates from the floor chain system of operation to the balance beam system. The single pair of crabs for operating the tunnel sluice valves at the upper gates are of the type adopted in 1839 to replace the in-tunnel sluice valves installed at the time of the canal's construction.
Canoeists at the Isthmus lock. (John Borrowes, pencil sketch, Public Archives of Canada, C-18798.) When Lt. Col. By raised the level of upper Rideau Lake 4 1/2 feet by constructing a dam and lock at the Narrows so as to reduce the excavation required in the canal cut across the summit isthmus by a corresponding depth, he was forced to construct a lock at the opposite end of the canal cut to maintain the higher water level. At both the Isthmus and the Narrows where the lifts were comparatively small, Lt. Col. By dispensed with a breastwork placing the upper sill on the same level as the lower sill. Since the bottom part of the upper gates was, like the lower gates, continually under water and below the level of any boat in the lock, he was able also to dispense with tunnel sluices at the upper gates in favour of the far less costly gate sluices without any fear of flooding or damaging the cargo of boats ascending the lock.
Map of Canadian military/commercial canals ca. 1834.
(Map by Steve Epps.)

A Grenville Canal: 7 locks, - 3 locks, 20 ft. by 108 ft.  
- 4 locks, 33 ft. by 134 ft.
B Chute à Blondeau Canal: 1 lock, 33 ft. by 134 ft.
C Carillon Canal: 3 locks, 33 ft. by 134 ft.
D Lachine Canal: 7 locks, 6 lift locks, 20 by 108 ft.  
1 regulating lock, 20 by 108 ft.
E Vaudreuil Lock: 1 lock, probably 20 by 108 ft.
F Cascades Canal: 2 locks, 20 by 100 ft., 12 ft. 6 in. gate opening
G Split Rock Canal: 1 lock, 20 by 100 ft., 12 ft. 6 in. gate
H Coteau du Lac: 3 locks, 20 by 100 ft., 12 ft. 6 in. gate
J Tay Canal: 5 locks, 20 ft. by 100 ft.
K Rideau Canal: 47 locks, 33 ft. by 134 ft.

River Rapids:
1. Galops Rapids  
2. Rapide Platte  
3. Long Sault Rapids  
4. Coteau Rapids  
5. Cedars Rapids  
6. Split Rock Rapids  
7. Cascade Rapids  
8. Lachine Rapids  
9. Ste. Anne Rapids  
10. Carillon Rapids  
11. Chute à Blondeau Rapids  
12. Long Sault Rapids
Steamboats in action at the Battle of the Windmill, November 1838. (Illustration from A Narrative of the Adventures and Suffering of Captain Daniel D. Heutis, 1847, reproduced in Edwin C. Guillet, Early Life in Upper Canada, p. 686.) At the Battle of the Windmill near Prescott, Upper Canada, commercial steamboats armed and manned by British naval personnel proved vastly superior to gunboats propelled by sail and oar in transporting troops, ordnance, and supplies to the site of battle as Lt. Col. By had anticipated steamboats would as early as 1826-27. The speed and manoeuvrability of the steamboats was so vastly superior to the gunboats that the latter were rendered all but obsolete. Had the Rideau Canal been constructed on the scale of a gunboat canal with locks 20 feet by 108 feet as originally intended rather than as a steamboat navigation as advocated by Lt. Col. By, with locks 33 feet by 134 feet, the uncertainty and slowness of transport on such an extensive waterway would have proved an insurmountable barrier to the development of a mobile defence strategy during the 1840s when it became apparent that the static defence strategy propounded by the Duke of Wellington could not be implemented.
H.M.S. Mohawk, 1843. (John Ross Robertson Collection, Metropolitan Toronto Public Library.) In the aftermath of the Battle of the Windmill, the Admiralty scrapped the old gunboats that had been put back into service and proceeded to construct steam warships for service on the Great Lakes. Three paddle-sloop steamers were constructed: the H.M.S. Minos in 1840 for service on Lake Erie, and the H.M.S. Mohawk in 1842 and the H.M.S. Cherokee in 1843 for service on Lake Ontario. The H.M.S. Mohawk shared with a commercial steamer the distinction of being the first iron steamer on the Great Lakes. All of the paddle sloop steamers were intended for patrol duties to prevent armed incursions across the lakes by irregular forces such as the Hunters' Lodges, and were lightly armed. The H.M.S. Cherokee, for example, carried 18 guns consisting of 6 and 9 pounders.
U.S.S. Michigan, 1843. (Kuttruff, Ships of the Great Lakes, A Pictorial History, n.p.) The U.S.S. Michigan was built at Pittsburgh and assembled at Erie, Pennsylvania, where it was launched on 5 December 1843. This iron sidewheeler, 164 feet long with a 27 foot beam and 11 foot draught, was far superior to the paddle-sloop patrol steamers of the Royal Navy and threatened to revolutionize naval warfare on the Great Lakes. However, diplomatic initiatives resulted in the U.S.S. Michigan being armed with only a single 18 pounder in keeping with the Rush-Bagot convention of 1817 and avoided a potential shipbuilding race to construct steam warships on the Great Lakes.
Defensible lockmaster's house at Lock no. 32, First Rapids [Poonamalie]. (Edwin Whitefield, watercolour, [1854] Public Archives of Canada, C-13299.) Of the 16 defensible lockmasters' houses erected at various locksites on the Rideau Canal in the post-1838 period, 12 remain extant today in modified forms. All of the defensible lockmasters' houses appear to have had tinned roofs, and all but three were loopholed. They were sited so as to be able to provide a covering fire for the canal structures at the respective locksites, and were intended to withstand the musketry of small bands of marauders unaccompanied by artillery. Defensible lockmasters' houses appear to have been unique to the Rideau Canal.